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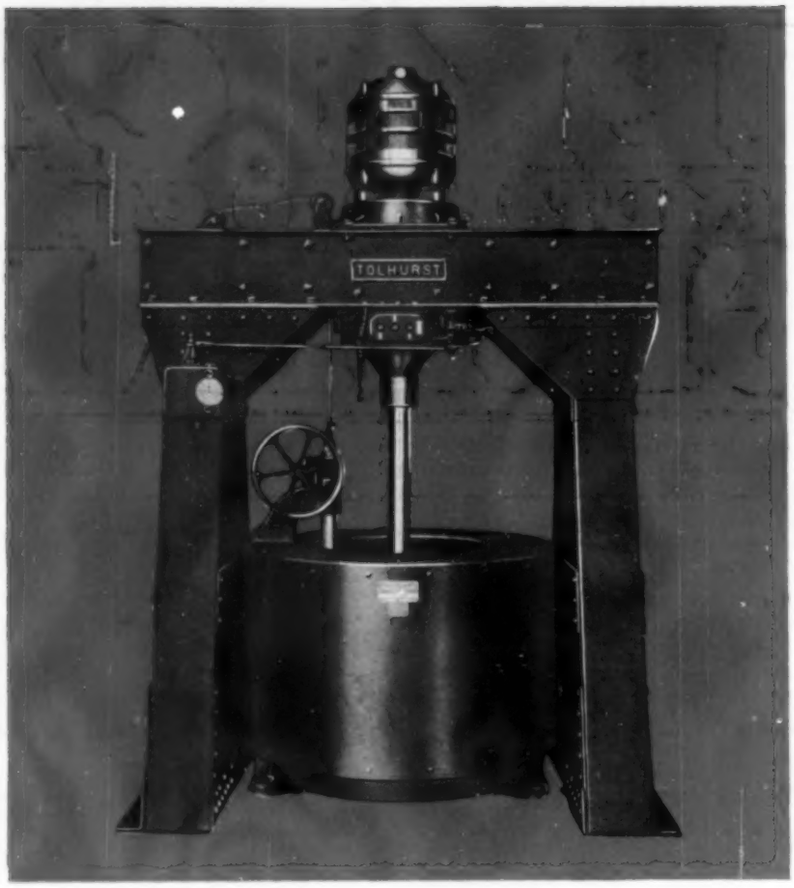

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NEXT MONTH'S *Chem. & Met.*, appearing in advance of the Asheville (N. C.) meeting of the American Institute of Chemical Engineers, is to have a distinctly Southern flavor. Its editorial features will include a review by H. C. Parmelee of the growth of chemical industries in the South, a discussion by B. G. Klugh of the electric-furnace phosphoric-acid process of the Federal Phosphorus Co. of Anniston, Ala., and a description by Norman W. Krase of the first American installation of the Suida direct acetic-acid process in the plant of the Forest Products Chemical Co., of Memphis, Tenn.

Well illustrated staff articles will describe the Champion Fibre Co., the new rayon plant of American Enka, the Hans Rees tannery, the Sayles-Biltmore bleachery, and the Beacon blanket works—all of the Asheville district. Another will treat of recent developments in Kingsport, Tenn.

Space here precludes the listing of other equally interesting features. Suffice it to say the editors have made an effort to reflect in full measure the great Southern March of Chemical Progress.

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VOLUME THIRTY-SIX NUMBER TEN

CHEMICAL & METALLURGICAL ENGINEERING

S. D. KIRKPATRICK, *Editor*

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S. D. KIRKPATRICK, *Editor*

Why Not an Investment in Co-operative Research?

COLLECTIVE action has been responsible for prompt improvement in many lines of industry. It is natural, therefore, that the first effective work of the Federal Farm Board, in laying out its program for the solution of our most important national problem, has been in developing the co-operative marketing organizations. Although the Board apparently has recognized the importance of research in relation to the farm problem, it has not yet used its financial resources specifically to promote such a worth-while activity. Chemical engineering industries concerned with the utilization of farm products as raw materials have a direct interest in making certain that the proper sort of research is undertaken.

AMERICAN agriculture probably has benefited from scientific research to the extent of billions of dollars, but the gain has been primarily in increased production. Now the emphasis must be placed on another type of research: not to produce more but to utilize what we have more effectively. It is here that the chemical engineer can be of most assistance, as a number of agricultural industries have already learned to their full advantage.

THE citrus producers of California were among the first to recognize the opportunity to capitalize on their chemical byproducts. The Exchange set up its own plant to produce citric acid and lemon oil from cull fruit or, in years of overproduction, from the excess crop. By pooling the output of the entire industry and sharing the total return on the basis of the production of the individual grower, the market was given only what it would absorb and the balance was diverted to byproducts. Another Californian industry—wine grape culture—has profited similarly. After a period of discouraging instability, the industry embarked on a program of co-operative research that led to the development of new uses and ultimately to a stabilization of the industry.

NOT ALL farm products hold the same possibilities for chemical engineering research but there are few that could not be benefited. The profitable utilization of farm wastes and byproducts will not be accomplished by the theorists who have been seeking sensational publicity in the daily press nor by the promoters of immature and sometimes fraudulent schemes to capitalize on the plight of the farmer. Results are more likely to be obtained by the industry organizations themselves. They have a better understanding of practical problems involved. They offer a greater opportunity for co-operation, and, in turn, co-operative research—just as it has done in many trade associations—will help them to knit together the interests of their members into stronger and more effective groups.

THE FEDERAL FARM BOARD has within its power an unusual opportunity to lend financial support to this type of co-operative research—not as an emergency relief measure but as an important part in a plan for the permanent improvement of agriculture. Chemists and engineers in other lines of industry may be counted upon to contribute to such a program, for the success or failure of agriculture will ultimately be reflected in all industrial activities.

International Amity Will Benefit Industry

WHEN two such splendid representatives of the great English-speaking nations as J. Ramsay MacDonald and Herbert Hoover can sit down on a log in a Virginia mountain camp and within a few hours dispose of major issues affecting the human welfare of hundreds of millions, it must be obvious that we have made a great deal of progress in international relations. The accord they reached so directly because of their utter frankness and sincerity has in it a lesson for those in chemical industry who would engender misunderstanding and distrust between countries.

After all, our basic industries are as international in character as the science and technology on which they rest. The great cartels of Europe that in their respective countries dominate such industries as chemicals and dyestuffs, synthetic fertilizers and rayon, differ but little from comparable organizations in the United States. All have their interrelations and interdependence in matters of raw materials, manufacturing processes and markets. As they have grown in size and resource they have projected themselves beyond their national borders just as American industry has been forced to find access abroad. No less authority than Dr. Julius Klein has estimated that the capital invested in foreign manufacturing enterprises owned wholly or in substantial part by Americans totals in excess of $1,300,000,000. From this he had eliminated such extractive industries as the mining and oil companies in Mexico, sugar centrals in Cuba, pulp forests in Canada, and nitrate plants in Chile (about half of which are now American-owned). Exclusive of our branch factories in Canada, of which there are nearly a thousand, two hundred American companies maintain more than two thousand establishments of this sort abroad.

Another aspect of international development is seen in the extent to which foreign countries are using American machinery and equipment as well as technical advice and engineering service. For the first time in history American firms are to participate in Achema VI, the German exposition of chemical industry, which will be held in Frankfort-on-Main next June. American engineers are building nitrogen plants in Germany and Norway. Our technologists, in scores it would seem, are being engaged by the chemical industries of Soviet Russia. Electric-furnace phosphoric-acid plants are being built in France under licenses issued in Birmingham, Ala. American metallurgical equipment—thickeners, filters and classifiers—are being installed in chemical industries of nearly every country of Europe. Nitrocellulose lacquers, synthetic phenolic resins, industrial glassware and other typically American developments are taking root in many countries either through branch plants or by manufacturing agreements with local industries.

With our industries and technology advancing at such a pace, it is time that we give some thought to our international relations—even in this period of tariff negotiation. Much can be accomplished if the problems are approached in the frank, friendly and generous attitude of the two great men who substituted a log on the banks of the Rapidan for the polished round table of the diplomats at Geneva. They dealt with fundamentals solely in the broad aspect of human welfare. Surely there can be no better formula for solving the international problems affecting industrial welfare.

New Standards for Industrial Statesmanship

MANY questions of wide importance to the many industries which are ably led by trade associations were considered in the recent meeting of the American Trade Association Executives. In no other action, however, was there a more forward-looking stand taken by these leaders than in their resolution on the ethics of association practice.

The furnishing of well-informed, constructive, and effective leadership, the collection and dissemination of information on a fair and open basis, and the promotion of integrity and sound public policy throughout industry are objectives sought. The association executives are to be congratulated on the leadership in business ethics which is thus evidenced.

It is clear that not all trade groups have yet profited by such leadership or recognized such ethical principles. Think how much more effective it would have been for American ship building had it been properly represented and frankly in the open with reference to merchant marine and naval development! We trust that there will be no Shearers engaged by other industrial groups. *Sub rosa* representation and propaganda of this type are ineffective and dangerous. They are unwarranted upon any basis of good sense or good business. Industrial statesmanship has new standards which it should learn and follow.

Weld Testing Becomes An Exact Science

TWO significant developments in weld testing were announced for the first time at the recent meeting of the American Welding Society. While the tests are described in some detail elsewhere in this issue, very briefly they consist, one in a method depending upon electrical resistance of the weld metal, a development of Elmer A. Sperry; and the other, in a combination of stethoscope and X-ray examination, the work of Kinzel, Burgess and Lytle of the Union Carbide and Carbon Research Laboratories.

The importance of the tests lies in the fact that they are non-destructive. By the use of one or the other it appears possible to determine with certainty the presence of defects in the deposited metal, as well as lack of fusion along the scarf, without damage to the weld. Not only is this possible but it also seems that the amount of damage that is likely to result from the defect can be foretold with considerable accuracy. But perhaps the most important feature of all is the psychological benefit that should accrue to the welding art in general. Skeptics in the past have always raised the plaint that a weld must be destroyed if certain knowledge of its quality is to be obtained. Although it was not a universal fact, the accusation has had an element of truth, sufficient probably to have hampered the spread of welding.

It must not be assumed that the new tests will revolutionize the examination of welds. They are accessories to the excellent testing systems that are already in use. On some types of welding it is possible that they will be used alone. But it is equally probable that hydrostatic tests and the well worked-out procedure control now current will continue to play their part in that division of welded equipment most important to the chemical engi-

neer, namely, pressure apparatus. For pinholes will still exist undetected by the new tests and metal will sometimes be burned or the composition of the weld otherwise altered adversely.

There is, however, this difference: Where before hidden defects could often go undetected even under the most stringent of pressure tests, the new methods will bare them immediately. If they are employed conscientiously upon welds made by careful operators, the chances of a dangerous condition going unnoticed will be nil. Even the most conservative will be forced to admit the complete safety of welds which have been put through their paces in the new manner. Therein lies the spectacular phase of these developments. Welds will gain something in safety, but an enormous measure in acceptance; and chemical engineering industry will be the winner.

Are Motor Benzol Specifications In Need of Modifications?

GASOLINE SPECIFICATIONS formerly required a water-white product of such nature that practically all unsaturated hydrocarbons of anti-knock value were removed in the course of manufacture. It now appears possible, although probably not yet fully demonstrated, that the practice in making motor benzol from coke-oven light oil is similarly at fault. This is an important question which should be adequately considered by motor-fuel blenders as well as those who are in any way interested in the production and marketing of motor benzol.

If by change in specification, or by change in motor-benzol use for gasoline blends, we can in some way increase the use of those anti-knock constituents of the original light oil, the result will be beneficial to all interested. Reports of tests of light oil made during low-temperature processing of coal indicate again that this may be an important possibility, especially with light oils which are formed at moderate retort and oven temperatures. If the anti-knock characteristic of benzol can be supplemented by other even more effective constituents the advantages of blended fuels will be augmented and the supply of motor gasoline of low detonating power extended. This is a possibility of large public importance, since the trend continues toward higher-compression motors with their greater tendency to knock with ordinary fuels.

Must Fertilizer Move From South to Southwest?

CHEMICAL ENGINEERING industries of the South, whoever lists them, include as one of their conspicuous number the fertilizer industry. This manufacturing group has suffered many vicissitudes during the period of post-war readjustment and agricultural depression. Now there appears a new factor which raises a question as to whether or not there may be forced upon the fertilizer industry the problem of geographic relocation.

Before the World War the Southeastern states grew virtually all the cotton that was fertilized. In fact, the states of North and South Carolina, Georgia, and Alabama consumed most of the fertilizer used on cotton, which is, of course, the greatest crop from the fertilizer point of view. Now more than 60 per cent of the cotton acreage lies west of the Mississippi, mainly in Texas and Arkansas; and the Western acreage grows every year in area and in importance. These fertile Western lands have not required as much plant food as do the Southeastern cotton areas. But it will be but a short time until this situation changes. The center of fertilizer consumption of the crop using the largest tonnages of fertilizer is inevitably going to lie west of the Mississippi within a short time, possibly even within the next decade.

With low concentrations of plant food in fertilizers and high freight rates which give no promise of lowering, it is a question whether the manufacture as well as the consumption of fertilizer will not be moved far to the west in the very near future. This deserves serious thought on the part of not only fertilizer men but also acid makers, byproduct-coke producers, and the several other heavy chemical groups whose welfare is intimately interwoven with progress in fertilizer production.

An Opportunity for Professional Service

AN IMPORTANT PART in the development of chemical engineering in this country has been played by the American Institute of Chemical Engineers since it was founded twenty-one years ago. More is yet to be done, however, in extending the influence of the organization, not alone in technology and its industrial application but in the broader relations of the chemical engineering profession. That the membership of the Institute recognizes the necessity for this further development is evident from the returns of the recent questionnaire on changes in certain matters of organization and publishing policy.

An overwhelming majority of the votes cast by the members favored the employment of a paid business manager or executive secretary as the first step in placing the Institute on a more businesslike basis. It is obvious that the affairs of the organization have grown to such an extent that permanent headquarters and adequate office facilities are necessary for the conduct of its business. It is likewise evident that this rapidly growing volume of association business cannot be carried on indefinitely as a labor of love on the part of any single individual. There is, therefore, in the work of the Institute a real opportunity for some representative chemical engineer to devote his full time and energy to the development of the organization. Changes in publishing policy, the extension of its membership, and perhaps the establishment of research or other pertinent activities are all problems that can be easily solved once they become the principal concern of some strongly centralized agency.

Chem. & Met. suggests that any chemical engineer attracted to the idea of carrying forward this important work should write to the office of the secretary of the American Institute of Chemical Engineers, 10th Avenue at 36th Street, New York City. All communications will be considered confidential, and additional suggestions from members or non-members as to personnel or organization policy will be especially welcome.

Seaboard liquid purification absorber. Ammonium sulphate absorbers at the left.

NEW PROCESSES

Aid in Manufacture of

CLEAN GAS

By D. L. Jacobson
The Koppers Company, Pittsburgh, Pa.

UNTIL recent years, the purification of gas manufactured from coal or coke was restricted to the removal of hydrogen sulphide. Tar and ammonia also were removed from the gas, but these constituents may in general be looked upon as byproducts to be recovered, rather than impurities to be eliminated. Any other purification that may have occurred was incidental to hydrogen sulphide removal and insignificant in effect. As a matter of fact, the purification of gas from hydrogen sulphide by dry oxide boxes usually involved the addition of oxygen to the gas for revivification, thus increasing the oxygen impurity.

When purification of gas is limited to hydrogen sulphide removal, many other undesirable substances remain in the gas. Moisture and oxygen, important factors in corrosion, are present and their injurious effects are accentuated by the presence of hydrocyanic acid and other impurities. A million cubic feet of gas leaving the holder at 70 deg. F. and cooling in the distribution lines to 40 deg. F. deposits 800 lb. of water. This water collects in drips which must be pumped frequently; and under severe winter conditions the moisture may deposit as frost, blocking service lines and requiring increased distribution labor. Corrosion results in accumulations of rust which may cause constrictions of the mains and service lines. Naphthalene frequently deposits as a solid, especially where low temperatures are encountered in the distribution system, temporarily constricting or blocking the flow of gas. The resin-forming constituents in the gas tend to polymerize and solidify as gummy deposits in meters. In addition, leather meter diaphragms are subjected to corrosion from condensed moisture.

These impurities are briefly:

Moisture—An important factor in corrosion and in causing chemical attack of meter diaphragms; deposits in pipe lines, etc., as a liquid or solid.

Oxygen—An important factor both in metal corrosion and in formation of gummy deposits.

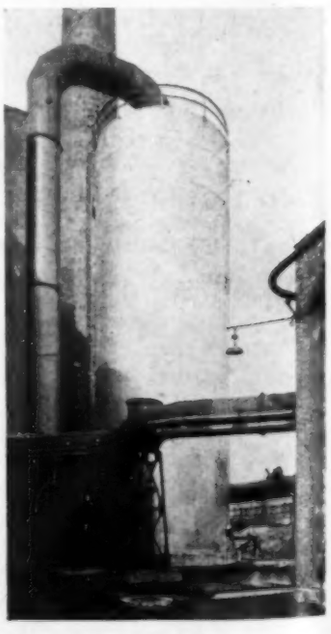
Hydrocyanic acid—An important factor in metal corrosion.

Naphthalene and resin-forming constituents—Naphthalene deposits as solid, blocking or constricting gas flow; gummy deposits occur in meters, etc.

Organic sulphur compounds (CS_2, etc.)—A factor in corrosion; yield sulphur dioxide when the gas is burned.

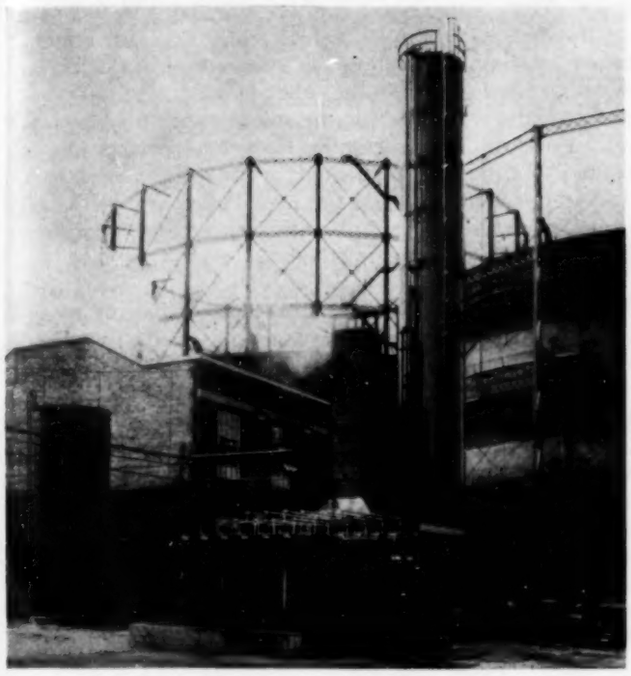
The past ten years has seen rapid development in new methods and apparatus for the removal of the various impurities from gas. New methods of liquid purification which remove all of the hydrocyanic acid, as well as the hydrogen sulphide, and which eliminate the necessity of adding oxygen to the gas, have been widely adopted. New processes and apparatus for the removal of moisture, naphthalene and resin-forming constituents have been perfected. The first plant in America to dehydrate manufactured gas has been put into operation at Grand Rapids, Mich., and several others will soon follow.

Seaboard Liquid Purification Actifier Showing Actifier Air Piping to Producers and Boiler

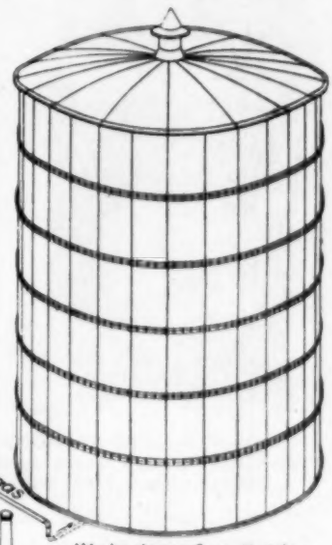


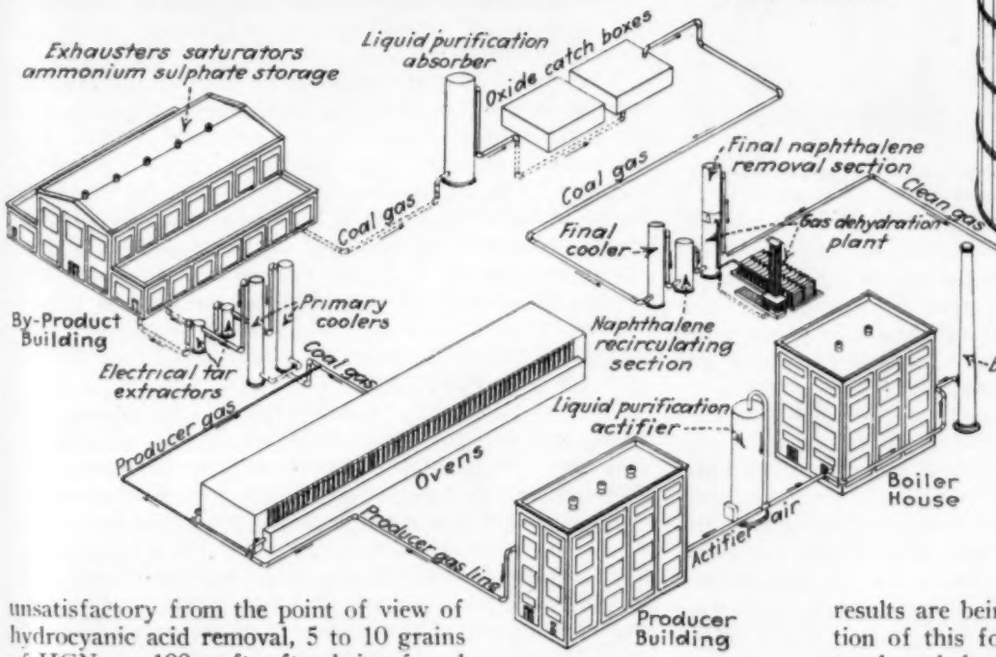
As part of the present article, a model gas plant will be described, with special emphasis on equipment for the production of clean gas. The cost of the additional treatment of gas also will be discussed and the desirability of producing high quality gas will be shown from the operating and financial points of view, and from the standpoint of superior service to the consumer.

Whether dry oxide boxes or liquid purification be used, the hydrogen sulphide must be completely removed from the gas. However, dry boxes are



At Left, General View of Gas Dehydration Plant at Grand Rapids (Mich.) Gas Light Company





Essential Features of a Model Plant for the Production of Clean Gas. Note Gas Dehydrating Plant, Pictured at Upper Left, in Center of the Drawing

combustion in boilers, gas producers, water-gas machines and in the heating flues of gas retorts and ovens.

The Seaboard process, being the simplest and most economical to operate, has been the one most widely adopted. In other cases, where the actifier air cannot be disposed of readily, sulphur-recovery liquid purification plants are in operation with excellent results. These sulphur-recovery processes include the Thylox process, employing a clear chemical solution, and other processes using suspensions. They are characterized by the conversion of hydrogen sulphide in the gas to free sulphur. The sulphur is removed by filtration and constitutes a credit to the process.

The sulphur recovered in the liquid purification processes of the sulphur-recovery type differs from ordinary brimstone in possessing an extremely fine particle size. This property makes it an especially valuable fungicide. Remarkable results are being obtained in the application of this form of sulphur to agricultural and horticultural uses and large quantities are being sold for these purposes. In addition, sulphur recovered in the Thylox process is being converted into commercial brimstone at a number of gas plants, so that both markets are open for the sale of this new byproduct from gas purification.

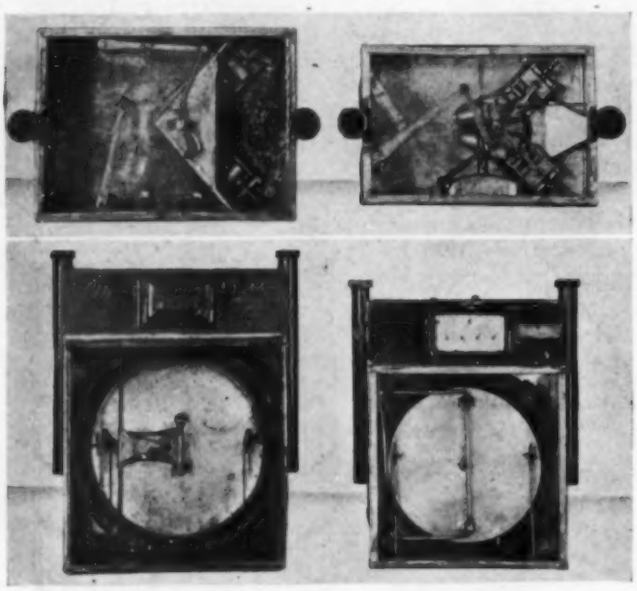
unsatisfactory from the point of view of hydrocyanic acid removal, 5 to 10 grains of HCN per 100 cu.ft. often being found in the gas after such equipment. Liquid purification, on the other hand, removes all of the hydrocyanic acid from the gas. The oxygen content of the gas is not increased in using liquid purification, as no air is required for revivification as in dry purification.

A full discussion of the various liquid purification processes would be beyond the limits of the present paper, but a few of the essential points will be touched on here. There are two types of liquid purification process in use in the United States, the Seaboard and the sulphur-recovery processes. The Seaboard process employs a clear soda solution in a gas scrubber, and transfers the hydrogen sulphide from the gas to a large volume of actifier air. This actifier air, containing a very low concentration of hydrogen sulphide, is discharged in some plants through a tall stack to the atmosphere. In other locations, where the actifier air would cause an odor problem, it is used as the air supply for

The Seaboard process usually removes 85 to 95 per cent of the hydrogen sulphide from the gas, while the sulphur recovery processes ordinarily remove about 98 per cent of the hydrogen sulphide. The remaining traces of this impurity generally are removed by dry iron-oxide catch boxes. The combination of liquid purification with catch boxes usually is the most economical arrangement. When it is desired, however, liquid purification may be operated so as to effect complete removal of hydrogen sulphide from the gas, and under certain local conditions this arrangement will be found economical, especially where ground space is very valuable.

The removal of moisture from the gas is carried out

in the dehydration scrubber, which may be combined with a scrubber for naphthalene removal. While naphthalene removal plants have already been adopted quite widely in the United States, gas dehydration is a relatively new feature in the improvement of gas quality. Processes for the removal of moisture from gas have undergone a parallel development in the United States and in Great Britain, where apparatus for drying gas has been installed in a large number of plants. The developments



Views at the Left Show Top and Front of Gas Meter After Use for Two Years on Wet Gas. Two Years on Dry Gas Show Little Effect in Views at Right

in gas dehydration have been carried out in England by W. C. Holmes & Company and in America by The Koppers Company. The two companies are co-operating in making all of these developments available to the gas industry in their respective countries.

Both gas dehydration and naphthalene removal are carried out in gas scrubbers, the gas being brought into contact with a hygroscopic solution for removal of moisture, while the naphthalene scrubber employs a petroleum oil (generally gas oil). The moisture absorbed by the hygroscopic liquor in the dehydration scrubber is evaporated from part of the liquor in an atmospheric evaporator. The hygroscopic liquor is recirculated continuously through the gas scrubber and a liquor cooler which takes up the heat of condensation.

THERE ARE advantages in arranging the naphthalene oil-scrubbing section to follow the dehydration section. The naphthalene scrubber operates at a higher efficiency with no possibility of water condensing in the oil. Any hygroscopic solution carried forward mechanically by the gas will be scrubbed out by the oil and prevented from entering the distribution system; while any oil vaporized or carried forward by gas will help to maintain an oil-moist condition in the mains and services, which is very desirable. The oil-moist condition of the pipe lines is positively insured by atomizing oil at various points in the distribution system. Special devices have been developed for carrying out the oil atomization efficiently.

While moisture generally is present in the gas, and gas dehydration apparatus must be installed if condensation and its attendant evils are to be avoided, in some cases, where gas is compressed for purposes of long-distance transmission, satisfactory dehydration may be accomplished by simply installing an efficient after-cooler on the compressed gas. On the other hand, it is uneconomical to compress the gas for the sole purpose of dehydration. For locations where the high-pressure gas line is exposed to atmospheric cooling for long distances, after-coolers are insufficient and the installation of a dehydration unit employing hygroscopic liquor and operating under the high pressure is advisable.

IN THE DRAWING on the preceding page the essential features of a model plant for producing clean gas are shown. This plant is meant to be illustrative only, and many variations will be found advisable under special local conditions. The course of the gas throughout the plant is indicated by the arrows on the drawing. The gas is produced from coal in modern oven units of high capacity, with oven walls evenly heated by producer gas so as to make a uniform, high quality coke. After the gas is cooled and tar deposited, the coal gas is mixed with a small amount of producer gas, the mixture being adjusted according to the calorific value of the coal gas so that the final mixed gas will be of absolutely constant heating value. The mixed gas is then cooled in a direct-contact primary gas cooler, after which any tar particles remaining in the gas are removed by an electrical precipitator.

The gas is sucked through the apparatus by an exhauster in the byproduct building, which then forces it through a sulphuric acid bath in a saturator in which the ammonia is absorbed from the gas to form ammonium sulphate. The gas at this point is hot and the Seaboard liquid purification absorber both cools the gas and removes hydrogen sulphide and hydrocyanic acid. The remaining traces of hydrogen sulphide are removed in the oxide catch boxes, after which the gas may be cooled further in a direct water cooler or final cooler. The additional cooling increases the efficiency of naphthalene removal and dehydration.

The gas then passes in series through the oil recirculating scrubber for removal of part of its naphthalene and then through the dehydration section where the moisture is removed from the gas by the hygroscopic liquor. The napthalene extraction from the gas is then completed in the secondary oil section into which small amounts of fresh oil are injected periodically. The double scrubbing of the gas by oil is carried out for the purpose of obtaining efficient naphthalene removal with the addition of only extremely small quantities of fresh oil (about 15 to 20 gal. of oil per million feet of gas). Substantial removal of the resin-forming constituents from the gas is simultaneously effected. The atmospheric evaporator and cooling coils, which are auxiliary to the dehydration plant are also shown. After leaving the naphthalene shot section, the gas passes to the waterless gas holder.

The solution leaving the liquid purification absorber is regenerated in the actifier tower by a large volume of air. The producer and boiler blowers pull this air through the actifier, and deliver part of it to the boilers and part to the gas producers.

The model gas plant shown here portrays one example of modern plant design for the production of clean gas. The gas produced in the case shown is a mixture of coal gas and producer gas. In many locations, carburetted water-gas sets will be found a necessary part of the plant, so that the gas produced will be mixed coal and water gas. The ovens usually are heated with producer gas or

with part of the coal gas. Sometimes blue water gas is used. A recent and very successful development is the employment of blast furnace gas for oven heating. The heating value of the coal gas may also be adjusted by admixture of any of these low B.t.u. gases. This practice is highly desirable, as thereby irregularities in the heating value of the coal gas are evened out and a gas of uniform heating value is produced.

The organic sulphur compounds occur in relatively small amount in manufactured gas, as compared with hydrogen sulphide. Carbon disulphide is the principal organic sulphur constituent. Fortunately the quantity of organic sulphur is usually so small that this impurity can be neglected. In certain rare instances, however, where the gas plant is limited in its choice of coal, a high-sulphur coal may be the only one available. Under these conditions, the removal of excessive amounts of organic sulphur from the gas should be carried out to improve the gas quality. If benzol is scrubbed from the gas by oil, sufficient removal of organic sulphur can usually be obtained by regular operation of the benzol scrubbers, or if desired, more efficient sulphur removal may be accomplished by increasing the rate of oil circulation. Where a choice is possible, it is strongly advisable to select a low-sulphur, low-ash coal for carbonization so as to produce a higher grade coke product. Other conditions being equal, the amount of total organic sulphur compounds in the final gas depends on the amount of sulphur in the original coal. For example, one gas plant uses coal containing only 0.65 per cent sulphur and produces a gas with an organic sulphur content averaging only 5 grains per 100 cu.ft. of gas.

The Cottrell precipitator has been found to be highly efficient in cleaning the gas from tar and is replacing the P. and A. tar extractor in a number of the newer installations. Equipment for the efficient removal of tar and ammonia is indispensible in a modern gas works producing clean gas.

The liquid purification plant shown is of the Seaboard type with arrangements for consuming the actifier air. For other cases where this layout is not suitable, a sulphur recovery liquid purification plant may be substituted with the same results as to purity of the final gas produced. With a sulphur recovery liquid purification plant, the final cooler should precede the liquid purification absorber.

The naphthalene removal system shown operates with a high efficiency and so as to produce an extremely small quantity of spent oil. Where carburetted water gas is produced, a single oil recirculating section may be placed on top of the dehydration section, omitting the naphthalene shot section. In this arrangement, much larger quantities of fresh oil are introduced in the naphthalene scrubber, the relatively large quantities of spent oil being sent to the water gas apparatus.

Gas dehydration can be carried out entirely satisfactorily either in connection with a waterless gas holder or with a water-sealed holder. Where the holder is water sealed, a layer of oil ½ to 1 in. thick is maintained over the water in the holder, thus preventing resaturation of the gas by the water.

IN THE MODEL plant described above, complete removal of hydrogen sulphide and hydrocyanic acid from the gas is accomplished, moisture is removed to such an extent that condensation does not occur, the oxygen concentration is kept at a minimum by avoiding the introduction of air into the gas, and naphthalene and resin-forming constituents are eliminated. The question then comes up as to what the fixed and operating charges will be for the improved plant, and how costs compare with the benefits derived.

TOTAL fixed and operating charges for the Seaboard liquid purification plant with catch boxes as described will amount to about 1 cent per thousand cubic feet of gas purified. Total costs for dehydration of gas and naphthalene removal will amount to about 0.75 cent per M cu.ft. of gas, including fixed charges. The sum total of all these costs is 1.75 cents per M of gas, and this figure may be compared with a cost (including fixed charges) of 1.50 cents per M for removal of hydrogen sulphide alone by dry iron oxide. For an additional cost of only 0.25 cent per M, hydrocyanic acid, moisture, naphthalene and resin-forming constituents can be removed from the gas by modern methods (and incidentally a low oxygen concentration maintained in the gas). The savings effected by removal of all these impurities are very substantial: the financial savings due to removal of moisture and naphthalene alone are estimated to amount to 1.5 to 3 cents per M of gas, the figure varying somewhat with local conditions.

Where a sulphur recovery liquid purification plant is used in place of the Seaboard plant, costs will in general be about the same as with dry boxes, but considerable savings will be effected in greatly reduced expenditure for ground space and in decreased costs for gas pumping because of reduced back pressure on the gas, in addition to the benefits derived from removal of hydrocyanic acid and oxygen from the gas.

It is worthy of note that the operating costs for the Seaboard process of liquid purification, including catch box operation, amount to an average of only 0.4 cent per thousand cubic feet of gas, the lowest operating cost figure for any purification process ever used, and less than half the operating cost for removal of hydrogen sulphide alone by oxide boxes.

The financial benefits obtained in connection with the clean-gas plant thus exceed very substantially the costs involved in carrying out the purification operations. It is equally significant that other benefits, somewhat less tangible but of great importance, are secured in the form of superior service to the consumer and in maintaining good will between the manufacturer of gas and the consuming public.

Recent Periodical Literature on Cleaning Gas

F. W. Sperr, Jr., "Dehydration of Manufactured Gas," *Gas Age Record*, October, 1926, p. 551, p. 585.

F. W. Sperr, Jr., "Dehydration of Manufactured Gas," *Chem. & Met.*, February, 1927, p. 97.

K. N. Kundall, "Recovery of Sulphur From Gas," *Chem. & Met.*, March, 1927, p. 143.

A. R. Powell, M. Merritt and J. F. Byrne, "Removal of Naphthalene and Gum-Forming Constituents," *Gas Age Record*, July, 1927, p. 3.

C. Harris, "Partial Drying of City Gas," *Gas Age Record*, December, 1927, p. 877, p. 917.

W. Gluud and R. Schönfelder, "Removing Hydrogen Sulphide From Coke Oven Gases," *Chem. & Met.*, December, 1927, p. 742.

F. W. Sperr, Jr., "Gas Purification in Relation to Coal Sulphur," International Conference on Bituminous Coal—1928, Vol. 2, p. 37.

A. R. Powell, "Naphthalene and Gum Removal," *Gas Age Record*, February, 1928, p. 141.

C. J. Ramsburg, "Some Manufactured Gas Technical Developments," *Gas Age Record*, Feb. 16, 1929, p. 205.

W. L. Shively, "Gas Dehydration in Practical Operation," *Gas Age Record*, April 6, 1929, p. 445.

D. L. Jacobson, "The Thylox Process of Liquid Purification," *Gas Age Record*, May 4, 1929, p. 597.

C. J. Ramsburg, "Observations on Gas Production," *Gas Age Record*, June 15, 1929, p. 813.

D. L. Jacobson, "The Seaboard Process with Utilization of Actifier Air," *Gas Age Record*, June 29, 1929, p. 895.

J. E. Spindle, "Experience in Gas Dehydration at Grand Rapids," *Gas Age Record*, July 13, 1929, p. 39.

Ammoniated Phosphate New Factor In Fertilizer Manufacture

By R. S. McBride
Assistant Editor, Chem. & Met.

Fig. 1—Ammonia Mixing Equipment at the Plant of Wilson & Toomer Fertilizer Company, Jacksonville, Fla.

AMMONIATION of superphosphate for fertilizer manufacture has been proved a commercial success by extensive trial in approximately 100 plants which have used ammonia liquor directly in fertilizer making. The result is not only a new economics of ammonia utilization, with the practical elimination of much unwanted nitrogen carrier; there is also an unexpected advantage in speed of fertilizer manufacture, an improved technique for the conditioning of complete fertilizers, and a possibility of greatly increased flexibility of fertilizer plant operation with attendant minor economies.

It has long been desired to use ammonia itself in fertilizer making without the necessity of having sulphuric acid or other carrier present to "fix" the ammonia. Now this ambition is virtually realized by making the acid of the superphosphate serve as carrier for ammonia and thus preclude the necessity of using additional acid, which was both expensive and an unwanted constituent of the finished products. Now that the successful procedure has been developed it seems strange that so simple and so obvious a scheme should not have been long ago applied. The scheme consists simply in running controlled amounts of about 25 per cent ammonia liquor into the fertilizer mixer where the superphosphate, salts, base goods, conditioners, and fillers are mixed.

Superphosphate made by conventional means necessarily carries a substantial amount of free acid, corresponding to the excess of sulphuric acid used with the rock above that which is required to react chemically with the original tri-calcium phosphate and convert it into mono- or di-calcium salts. This free acid, which can be assumed to exist in the form of free phosphoric acid, H_3PO_4, is, of course, readily neutralized by ammonia. Hitherto it has been the custom to neutralize it with lime, calcium cyanamide, or other base, so that the presence of the free acid would not make the mixed goods subject to secondary caking, or corrosive and objectionable for handling because highly active in rotting the bags used for handling and storage. With the new process the neutralization takes place directly with ammonia and the result is not unwanted additional calcium salt, but additional available plant food in the form of ammonium salt.

The heat given off by reaction by the ammonia and acid, and by the readjustment of chemical conditions in the mixture, serves to evaporate part of the water added in the liquor, so that the water in the finished mixture is always less than the total amount introduced by the liquor and other ingredients. It is necessary to control the evolution of this heat very carefully for two reasons. If excessive heating occurs in the mixer there is a tendency for the setting up of unwanted reactions which convert some of the phosphate into insoluble "unavailable" form. In the second place, the temperature must be sufficient that the mixed product will be of the proper physical condition and contain close to the desired percentage of moisture. With proper temperature control,

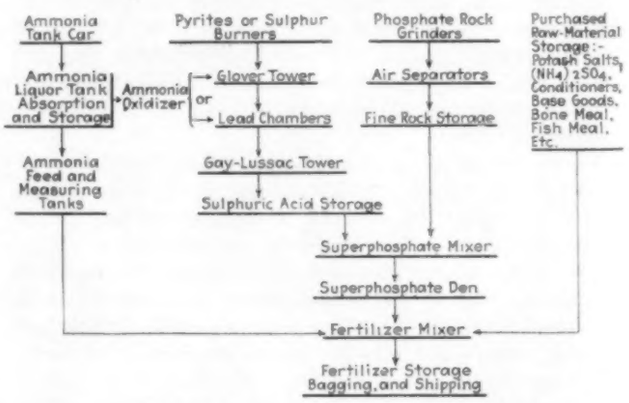


Fig. 2—Flow Chart of Superphosphate Manufacture Showing Direct Use of Ammonia

obtained by proper mixing conditions, the resulting fertilizer has been found, much to the surprise of those using the new process, to be superior in physical condition to fertilizers made without ammonia liquor. It not only is in better physical condition initially, but it is of low hygroscopic power and hence is not subject to caking in bags or in stock piles to the same extent as other equivalent-composition goods made without liquor.

Other parts of the superphosphate fertilizer manufacture are but little modified by this new scheme of

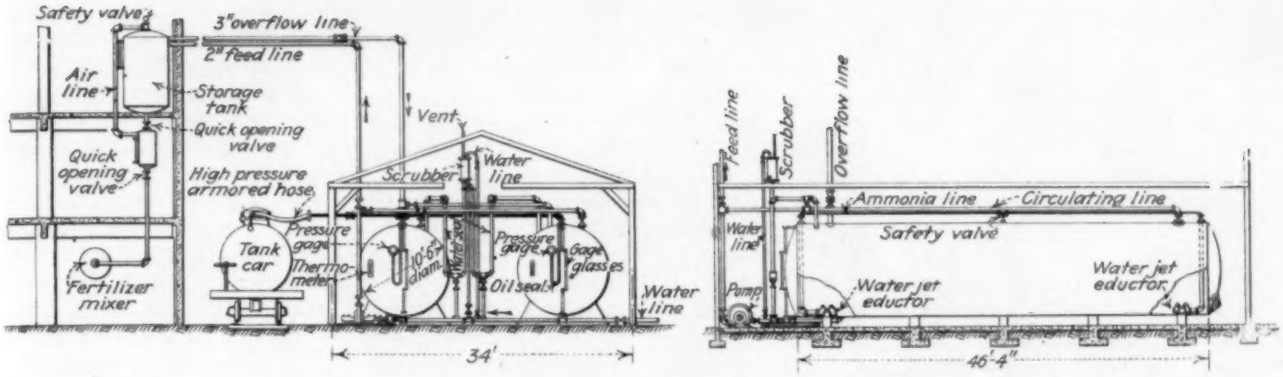


Fig. 3—End and Side Elevations of Plant for Making Ammonia Liquor From Anhydrous Ammonia as Recommended to the Fertilizer Industry by the Barrett Company

Two large tanks serve both for dissolving the ammonia in water and for plant storage of the ammonia liquor. As anhydrous ammonia tank cars will carry 50,000 lb. or more of NH_3 and as a solution of about 25 per cent will usually be required, it is recommended that each tank be large enough to hold at least 200,000 lb. of liquor. Tanks of 30,000 gal. or more capacity of ⅜-in. steel for 25 lb. pressure are therefore suggested.

In the set-up shown here each tank is supplied with two all-iron eductors of standard pattern to serve as ammonia jets and to act as mixers to circulate the tank contents. The jet size is chosen so that the flow of ammonia will be at the optimum rate when the feed valve is fully opened. This rate depends upon the cooling facilities available. If a water spray is provided over the tank for summer use, the rate can usually be from 1 to 2 tons of ammonia per hour.

While the ammonia is being dissolved the tank is vented through a small water scrubber shown in detail in Fig. 4. The water used in the scrubber flows into the solution tank so that provision is made for this in the initial measurement of solution water. While the tanks are being used for storage the water seals are filled with aqua ammonia and the scrubber is not used. A pump is provided to transfer liquor to the fertilizer building, to fill the water seals and to circulate liquor during dissolving should this prove necessary.

ammonia use. The typical flow sheet which accompanies this article shows how the use of ammonia liquor leaves almost unchanged the procedure of superphosphate making and mixing. There is, however, one detail which can be modified at the option of the management, and often with great advantage. This is the quantity of excess acid used above that theoretically required for chemical reaction with the phosphate rock. Hitherto it has been desired in fertilizer making to limit the excess acid employed as severely as possible without running the risk of leaving much of the rock unavailable in the insoluble form. As a consequence of such limitation of excess acid, the time required for reaction between rock and acid was materially extended and aging in the den or the pile has been necessary.

The objection to excess acid is, of course, greatly lessened by the fact that it is merely going to be a carrier for ammonia. Hence plants using the new process are at liberty to use larger quantities of acid and obtain much faster reaction up to the point of practically complete availability of P_2O_5 in the water-soluble or citrate-soluble form. Of course the use of increased quantities of acid can readily be carried to an undesirable extreme, even with the new process. Hence, the change is rather quantitative than a significant qualitative one.

The quantity of ammonia which may be added as liquor is limited primarily by the amount of acid present in the superphosphate. The neutralization of this acid by ammonia, as in the case of lime or cyanamide, must not be carried too far or some of the phosphate present will revert to tri-calcium phosphate and become unavailable and hence not credited in the official fertilizer analyses. Up to the point of causing this reversion ammonia can be used freely. The point at which one investigator recommends that the addition should stop is practically that at which two mols of NH_3 are added for each mol of water-soluble P_2O_5. This point is that at which the neutralization has reached approximately the point equivalent to the compound $(NH_4)_2HPO_4$, or what is acidically equivalent, $CaHPO_4$. So long as this point is not passed, practical experience indicates, as chemical theory would imply, that substantially all of the P_2O_5 remains in available form.

Superphosphate as made ordinarily contains a total of approximately 18 per cent available P_2O_5 with usually less than one-half of one per cent of insoluble P_2O_5 as tri-calcium, iron, or aluminum phosphate. Of the 18 per cent available, usually about one-sixth is present as free acid, a somewhat smaller portion as di-calcium phosphate which is citrate soluble, and the balance (about 13 per cent) as water-soluble mono-calcium phosphate. After complete reaction with ammonia in the proportions indicated above, all of the phosphates behave as if present as either di-ammonium or di-calcium salt. As a matter of fact the ammonia is probably present as sulphate and about half of the available phosphate takes on the form of a di-calcium compound. However, the exact distribution of acid and base radicals in these compounds is not yet well understood, but the practical method of control has been worked out which indicates about the distribution given.

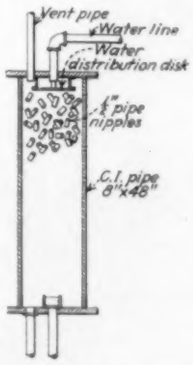


Fig. 4 — Detail of Small Water Scrubber Used to Prevent Ammonia Loss in Making Ammonia Liquor

Strangely enough, the likelihood of reversion of the phosphate seems greatly reduced by the presence of ammonium sulphate in the fertilizer. Still more strangely, it seems that it makes relatively little difference whether this fertilizer salt is present when the ammonia is added to the superphosphate or whether it be mixed with the ammoniated goods at a later time. The presence of potassium sulphate, on the other hand, seems to increase the likelihood of caking the ammoniated mixtures. And, of course, superphosphates which have been in any way neutralized with caustic materials, for example those which have been limed, cannot be ammoniated without over-neutralization and reversion, as will be evident from the chemical considerations.

In a few cases plant men, not content with so great progress as the use of ammonia liquor represents, have undertaken to ammoniate directly in the mixer with NH_3 in the gaseous form. It is interesting to note that even

with these extreme conditions of ammoniation, it seems possible to maintain substantially 100 per cent recovery of the ammonia in the mixed fertilizer. All losses which occur apparently are those due to leakage or seepage of ammonia liquor from the ammonia handling system and are not due in any way to failure to obtain completely the desired reactions in the mixer.

Economics of ammonia utilization require quite a new approach now that this process has become a commercially significant factor. It is no longer necessary for coke and gas plants making byproduct ammonia or for producers of synthetic ammonia in anhydrous form to contemplate marketing to the fertilizer man only as ammonium sulphate. It is entirely practicable to ship ammonia liquor from the coke works or ammonia in anhydrous form from the synthetic plant and have these used by the new scheme in fertilizer making.

THE freight rate per ton for ammonia liquor is the same as that for ammonium sulphate and the two products as shipped contain approximately equal percentages by weight of ammonia. The freight rate for anhydrous ammonia is 1.75 or more times the ammonium sulphate rate; but the anhydrous form, of course, carries approximately four times as much nitrogen. Hence, the rate per ton of useful constituent is usually lower on the anhydrous than on either sulphate or liquor.

This last relationship has suggested to some the extreme view that in the future coke and gas works may make anhydrous ammonia in order to take advantage of the lower transportation cost from the byproduct producing plant to the user's fertilizer works. However, it is not to be expected that coke works already having installed direct-sulphate equipment will tear this out and replace it with liquor towers and anhydrous ammonia units. Moreover, managements building new byproduct works cannot consider only the freight relationships above discussed. They have to consider also the greater cost of making their byproduct ammonia in anhydrous form than in the form of liquor and the greater cost of storing anhydrous than sulphate. Only in the extreme case where the saving in freight rate for anhydrous was greater than the extra cost of making this form, would it be sound chemical engineering to contemplate the anhydrous product. Only time can tell whether and where such conditions may be found, if at all.

Fig. 5—Equipment for Making Ammonia Liquor at the Plant of Meridian Fertilizer Company, Shreveport, La.

Liquid-ammonia handling at fertilizer works would not have been contemplated with pleasant anticipation a few years ago. The developments which have formed a part of the chemical engineering involved in making ammoniated superphosphate practical have, therefore, had to include the development of a safe and convenient process for such handling of the anhydrous ammonia. The new technique takes advantage of the negative heat of vaporization of liquid ammonia to offset the positive heat of solution of ammonia in water. By injecting liquid ammonia direct from the tank car into the plant storage tank filled with water a direct conversion is accomplished from liquid to liquor. The heat which must be dissipated in this process is only about one-third that which would have to be cared for if the solution of ammonia gas in water were undertaken. Very successful equipment has been developed and is in convenient regular operation at the plants which are using the ammoniated phosphate process. The general character of the extremely simple equipment required is clearly shown diagramatically in Fig. 3.

Using two liquor tanks, as recommended, any fertilizer works can handle a full tank car of liquid ammonia promptly; and without delay of the car or demurrage charge can within about 24 hours transfer the liquid ammonia from the tank car into the plant storage tank as liquor of the desired strength. In general, the liquor so made is 25 per cent by weight NH_3. A number of experiments have been made on the production of liquor 30 or 35 per cent NH_3 by weight, all with full success. The exact concentration of liquor desired is readily adaptable by simply proportioning the water placed in the absorption tank properly to the weight of liquid ammonia in the tank car to be unloaded. For plants which wish to operate with 30 or 35 per cent liquor this is entirely feasible. However, with higher concentration of liquor somewhat greater care in temperature control at the fertilizer mixer is necessary. However, for such formulas as make this practice desirable, or for plant conditions which make the use of less water in the liquor essential, entirely successful results are easily to be had. This potentiality of varying liquor strength is an important advantage in flexibility of plant operation to the manufacturer who may not otherwise be able to control the total quantity of water entering the mixer with the superphosphate or base goods.

INDIRECT advantages accruing from ammoniation of superphosphate have been cited. Not the least of these, though perhaps the most unexpected, has been the increased speed at which a fertilizer plant using this process can make finished bagged complete fertilizer. One plant using the process reported last season that it had been able to take orders and successfully fill them promptly for at least 10,000 tons of goods that this plant would otherwise not have been able to make in time for delivery to its customers. This condition was in part the result of the very late buying seasons experienced by the entire industry last year. Nevertheless, it suggests that peak demands on the industry are going to be met in the future with much greater efficiency and facility than hitherto because of the greatly shortened time of production which is now possible.

As a matter of fact, proper operation of ammoniated superphosphate plants permits with a few fertilizer formulas the direct bagging and shipping of complete fertilizer without ageing after the goods leave the mixer. This possibility, of course, eliminates the handling into and out of storage piles and affords great plant economy as well as a very great increase in flexibility of shipping

without increased production capacity. The new process seems to afford a large advantage to ammonia producers, opportunity for greater plant efficiency to fertilizer manufacturers, and a superior quality and a higher concentration fertilizer at a given cost to the farmer. All important elements interested in ammonia are, therefore, substantially benefited.

In conclusion, the author wishes to acknowledge the valuable assistance which has been given so cordially during the preparation of this interpretation by Dr. S. M. Wilson, chief chemist, The Baugh Chemical Company, Baltimore.

Small Oil Burner Gives Close Control on Lehr Fired With Producer Gas

A VERY INGENIOUS form of automatic temperature control has been applied to a large Amsler Morton lehr in the plant of the Sneath Glass Company at Hartford City, Ind. The lehr is 60 ft. long by 10 ft. wide and has a capacity of about 12 tons of glassware per day of 24 hours. This output consists mainly of wide-mouth ware and other specialties of various sorts.

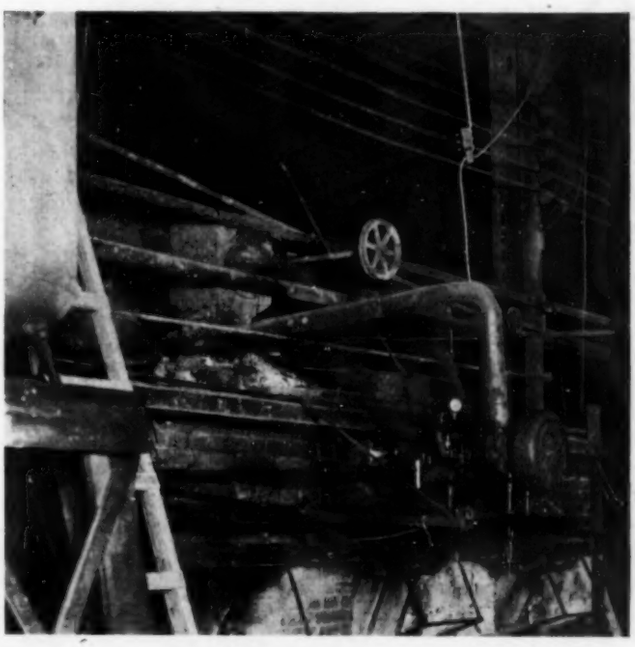
The lehr was installed originally about ten years ago and was intended to utilize producer gas as the sole fuel. It was equipped with a single burner outlet, located in the roof near the entrance end. Producer gas from a producer supplying gas fuel for the entire plant was led to the lehr through a 30-in. main, the take-off from which was manually controlled by means of a butterfly valve. This arrangement resulted in wide fluctuations in lehr temperature, sometimes more than 100 deg. F., with a resultant breakage of ware that often mounted as high as 15 per cent. Operation was complicated by a tendency for the burner to plug with solid matter carried over in the gas. This made frequent shutdowns for cleaning necessary and, of course, resulted in considerable lost time.

About four years ago it was decided to attempt automatic control of the temperature. It appeared that it would be extremely difficult to control the temperature accurately through regulation of the producer gas supply, as this amounted to over 2,000,000 cu.ft. per day, equivalent to 1-1½ tons of coal per day. Therefore, an indirect method was tried whereby the supply of gas to the lehr was maintained reasonably constant by occasional manual adjustment, while an auxiliary source of heat, which could easily be regulated with automatic equipment, was used to smooth out temperature fluctuations.

This source of heat consists of a Williams Oil-o-Matic burner of a type ordinariliy used for domestic house heating. Reference to the photograph will show the burner mounted on a light framework above the charging doors of the lehr, with the oil storage tank, elevated to feed the burner by gravity, at the upper left. In order to prevent the gas flame from blowing back into the oil burner when it is not in operation, a small duct above the burner is provided to introduce a blast of low-pressure air through the burner into the lehr. This not only keeps the burner cool but provides a portion of the combustion air required by the gas flame.

Operation of the oil burner, of course, is intermittent. It is started and stopped by a Brown automatic control pyrometer, which operates through a relay to close or open the circuit to the burner motor. The temperature is maintained within 10 deg. plus or minus of the control point. In other words, a temperature record for the lehr would not show a straight curve but rather a serrated line, with 20 deg. variations (that is, about 2 per cent) repeated at frequent intervals. Ordinarily the burner operates about 50 times per day, showing that it is able to bring the lehr very quickly to temperature. During the course of 24 hours, the oil consumption amounts to about 45 to 60 gallons, representing 10 to 15 per cent of the total fuel that is consumed in heating the lehr.

While the plant operates continuously for six days during the week, it is shut down on Sunday. In heating the lehr again after the shutdown, the oil burner is used alone to raise the temperature to about 600 deg. F., after which the producer gas is turned. Operating temperatures range from 900 or less to about 1,050 deg. F., depending upon the type of ware being annealed. Each type has determined for it by experiment a cooling curve which must be followed for best results. In attaining this, five thermocouples are read periodically on a single indicating pyrometer, and the control point of the pyrometer controller is changed slightly if the temperatures deviate from the curve. This, however, is not necessary except infrequently.



Williams Oil Burner, Controlled by Automatic Control Pyrometer, Gives Accurate Regulation of This Producer-Gas-Fired Lehr

In its more than four years of operation, this system of control has given excellent results. While it is not definitely known how much it has decreased operating costs, there is no question but that the reduction in breakage has paid for the installation many times over. Whereas breakage formerly amounted to 10 to 15 per cent on this lehr, and does today on several smaller manually controlled lehrs in the same building, it rarely goes over 1 to 2 per cent with this automatic control equipment.

Ceramic Coatings—an Outcome of Corrosion Difficulties in Oil Cracking

By J. C. Morrell and W. F. Faragher

Research Laboratories,
Universal Oil Products Company,
Chicago, Ill.

RAPID DEVELOPMENT and widespread use of cracking processes, and the increasingly large proportion of oils of high sulphur content which are used for cracking stocks, have introduced a critical problem into oil refining. In the past, a solution of the corrosion problem in the oil refinery has been important, but its importance is growing in direct proportion to the quantity of high-sulphur oils charged to cracking stills. The economic loss to the oil industry due to corrosion of pressure stills alone amounts to many millions of dollars a year.

Of the two general forms of corrosion in oil-refinery equipment, the least important—since a remedy for it has been found—is what might be termed "acid corrosion." This form of corrosion is exhibited mainly in the cooler parts of distillation systems such as the vapor line leading to the condenser, the condenser itself, and the receiver. It is due to the formation in crude batteries and cracking stills of hydrochloric acid, by the hydrolysis of magnesium and calcium chlorides, which, dissolved in condensed water, is highly corrosive. The same general kind of corrosion is found also in re-run batteries where thermal decomposition of sulphuric-acid derivatives in the treated oil yields sulphur dioxide as a primary product, which, in the presence of water, forms sulphurous acid. This is readily converted in an oxidizing atmosphere to sulphuric acid. Acid corrosion is readily combated by the injection of solutions of alkaline materials in the vapor line leading to the condenser; ammonia or its aqueous solution is preferable, since it leaves no residue.

However, the most destructive corrosion, and that with which we are principally concerned here, is caused by sulphur and its derivatives. So far as is known, sulphur in the form of hydrogen sulphide is the principal cause. Faragher, Morrell, and Comay (*J. Ind. Eng. Chem.*, Vol. 20, No. 5, p. 527, 1928) have shown that such compounds as mercaptans, sulphides, and disulphides undergo thermal decomposition to form H_2S and that elementary sulphur in the presence of hydrocarbons also forms H_2S at elevated temperatures. In fact, all known types of sulphur compounds which have been found in petroleum or its products, with the exception of thiophene, liberate H_2S at elevated temperatures.

From extensive experience with various kinds of cracking stocks, it has been observed that the extent of corrosion is not a function of the per cent of sulphur in the cracking stock, but apparently of the per cent of H_2S formed. This is due to the fact that types of sulphur compounds like thiophene do not undergo decomposition to form H_2S. No doubt, elementary sulphur is the cause of corrosion in some parts of the system.

The extent to which the sulphur compounds decompose increases with increasing temperature, hence a larger percentage of H_2S will be formed during the cracking reaction than in the atmospheric distillation of petroleum. The corrosive effect of the H_2S, owing to its greater concentration, is greatly increased in cracking equipment. Analysis of gases from the cracking of high-sulphur cracking stocks shows percentages of H_2S varying from 7 to 13 per cent. In non-residuum operation—i.e., operation in which only coke, distillate, and gas are made—as much as 800 cu.ft. of gas containing from 56 to 104 cu.ft. of H_2S per barrel of oil is formed from some cracking stocks.

DESTRUCTIVE effects of H_2S at elevated temperatures on various metals and alloys are shown in the following table (Egloff and Morrell, A. I. M. M. E., Feb. 17, 1927):

Metal Sample	Loss of Weight in G. per Sq.In. Surface Exposed
Aluminum	0.004
Duraloy	0.010
Enduro	0.010
Ascoloy	0.046
Resistal No. 4	0.064
Resistal No. 8	0.077
Atha No. 2600	0.175
Armco Iron	1.11
Steel	1.19
Copper-bearing Steel	1.65
Calorising "C"	2.39
Monel Metal	3.85
Copper	Entirely reacted upon

The test was made under practical conditions while cracking 17,000 barrels of California oil containing 1 per cent of sulphur at a temperature of 860 deg. F.

Wilson and Bahlke (*J. Ind. Eng. Chem.*, Vol. 17, 1925, p. 357) also carried out tests on metals and alloys in pressure stills, using a cracking stock containing 0.25 to 0.3 per cent sulphur. The following table gives the comparative effect of corrosion on strips of various

See article by J. C. Morrell, W. F. Faragher and V. Mekler in the Dec. 6, 1928, issue of *Oil and Gas Journal*.

metals suspended in the upper part of the cracking still at a temperature of 735 deg. F.

Metal	Loss Mg./sq.cm. per Run	Number of Runs
Aluminum	None	60
Calite casting	None	60
Calorized plate	None	50
Duralumin	None	10
Stainless steel (Firth-Sterling)	0.03	33
Ascoloy	0.03	94
Aluminum bronze	0.11	38
Galvanized iron	0.55	50
Zinc	0.60	10
Cast iron	2.73	30
Vismera steel	2.96	10
Special Climax alloy steel	3.32	33
Still-bottom steel	3.44	30
Copper-bearing steel	3.49	10
Low chromium alloy steel	3.68	20
Wrought iron	3.69	10
Monel	3.85	10
Bronze	19.25	10
Brass	21.80	10
Copper	40.60	10

Here again those metals which show high resistance to corrosion are either unsuitable or too expensive for the construction of the larger elements of cracking equipment.

The metals were suspended in the vapor zone of the reaction chamber, which shows the most marked effects of corrosion. Examination of the list indicates that those metals or alloys which show the greatest resistance are either unsuitable as construction materials owing to their inherent properties, or too expensive for building the larger elements of a cracking plant, such as the cracking chamber and dephlegmator. Mild steel, the usual construction material, showed a high rate of corrosion.

The corrosion of pressure-still equipment carries the exceptional danger of rupture of the corroded parts. The economic loss results from the necessity not only of placing new elements in the cracking system, but also of constantly decreasing the pressure on the cracking unit as corrosion progresses, with resultant decrease in the yield of motor fuel.

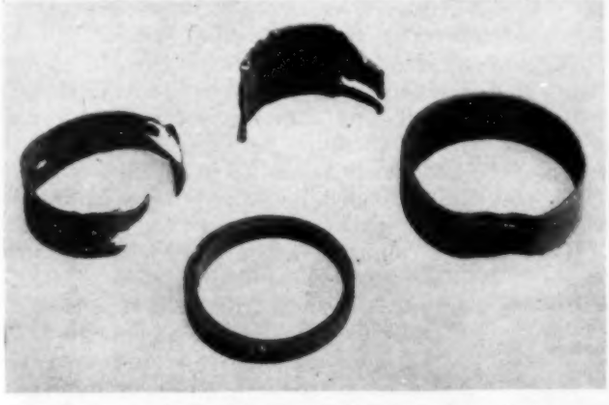


Fig. 1—Sections of Heating Tubes in Various Stages of Corrosion; New Tubing at Bottom

The principal methods of combating corrosion which have been suggested or tried may be summed up as follows:

(*a*) Manufacture of pressure-still equipment from highly resistant alloys such as chrome iron or chrome steel. While suitable for manufacturing corrosion-resisting heating tubes and vapor lines, they are too expensive for the manufacture of reaction chambers and dephlegmators. Generally speaking, their suitability for these purposes has never been demonstrated. Tubes made of an alloy containing approximately 18 per cent chromium, 8 per cent nickel, and 74 per cent iron have been found to give satisfactory service. Not only are these tubes resistant to corrosion but also, owing to the presence of nickel, do not undergo embrittlement. The elimination of corrosion from the return bends and plugs is important, and apparently the only present solution of this problem is in the use of corrosion-resistant alloy steels.

(*b*) Calorized steel surfaces. Calorized tubes with heavy walls are satisfactory in resisting corrosion, but this resistance is cut down at the ends of the tubes where they are rolled into the return bends, evidently owing to the breaking down of the protecting film.

(*c*) Injection of chemicals (principally of alkaline materials, such as caustic soda, soda ash, lime, and ammonia) has not been entirely satisfactory, and at best the results are irregular.

(*d*) Plating and coating by spraying with corrosion-resistant metals has not yet proved satisfactory. Lining reaction chambers with steel or alloy-steel plates is expensive, and many difficulties have yet to be overcome in preventing buckling, cracking, or turning away of the lining from the wall of the vessel.

It is evident that protection of the larger elements of the cracking equipment such as the reaction chamber and dephlegmator is the principal economic problem. In addition to this and of secondary importance is the protection of storage tanks, large transfer-lines, and chemical treating equipment.

AFTER a careful study of the problem, it was concluded that a lining made of non-metallic materials of ceramic or mineral-like character would be the most economical and satisfactory solution of the problem of protecting the larger elements of refinery equipment and other equipment subject to corrosion. The selection of an inorganic heat-resistant binder practically resolves itself into the use of sodium silicate. From a large number of ceramic materials which were tested, the best results were obtained with mixtures of fireclay, flint clay, plastic clay, sand or silica, and smaller quantities of such minerals as asbestos and mica, the exact proportions of which will be given presently.

A satisfactory and successful protective coating of such mixtures for cracking vessels should have the following properties:

1. Resistance to acidic substances and gases, such as hydrogen chloride and hydrogen sulfide.
2. Permanency under rapid heating or cooling; i.e., having a co-efficient of expansion, crushing and tensile strength, and elasticity of properly related values.
3. Strong adhesion to the steel shell, chamber, or other surface to be protected and hardness to withstand hammering and cleaning of the inside surface of the chamber.
4. Ease of removal of adhering coke, pitch, and other materials which accumulate during the processing of the oil.
5. The coating must not crack during the initial drying operation, and must be free from blisters in the subsequent curing operation.
6. It is desirable that the mixture be such that it may be applied rapidly; e.g., by means of spraying, and that after proper curing a durable coating of from one-eighth to three-sixteenths of an inch may be obtained.

WITH this in mind, a large number of experiments were made to determine the proper proportions of components and the best types of materials. Satisfactory results were obtained with various combinations, a practical mixture was selected, and a method of application and curing devised. These findings are set forth in the following discussion.

Sandblasting—The chamber to be lined is cleaned thoroughly and sandblasted to remove all coke and oil. It is imperative that all oil be removed from the chamber wall in order to insure successful results with the lining. If the chamber has oil, pitch or coke on the walls, they should be dried with a suitable gas burner before sandblasting. The temperature of the chamber is quickly raised to about 800 deg. F. and kept at this temperature until the oil has been vaporized, the pitch carbonized, and the coke dried or loosened. A good draft should be maintained during the early part of the drying operation in order to avoid explosion of gases that may accumulate. Care should be taken that all lines into the chamber are disconnected and the openings blocked off before lighting the burner, thus preventing oil or gas vapors entering the chamber, which might become ignited, causing explosion and serious injury to workmen.

Any efficient sandblasting equipment is suitable and a water trap to insure dry air is inserted in the air line to the sandblasting apparatus.

The sand for sandblasting should be coarse and sharp, and it has been found that heating it increases the efficiency of the operation over 25 per cent. A white silica foundry sand has been found most suitable. In operating the sandblasting machine men should be fitted with close-fitting goggles and a respirator; this also holds for the application of the protective coating.

Preparation of Mixtures—The materials comprising a batch of lining material, a batch of brushing solution, and the amounts necessary for lining various portions of 10-ft. diameter reaction chambers, are listed below.

One Batch of Lining Mixture

Furnace cement	60 lb.
White silica foundry sand (90 per cent to pass through 50-mesh screen)	30 lb.
Asbestos, short fiber	1½ lb.
Water glass (Technical solution sodium silicate 40-43 Bé.; silica to sodium oxide ratio 3½ to 1)	1 gal.
Water, approximately (Enough to give proper consistency)	1½ pt.

One Batch of Brushing Mixture

Furnace cement	6 lb.
Water glass (same as used above)	1 gal.
Water (enough to thin to proper consistency)	3 pt.

Material for Various Portions of 10-Ft. Diam. Chambers
(Includes amount necessary for painting solution)

Batches	Area Lined	No. Lbs. Furnace Cement	No. Lbs. Sand	No. Lbs. Asbestos	No. Gals. Water Glass
1	Top head	66	30	1½	2
2	3½ ft. (side)	126	60	3	3
3	7 ft. (side)	186	90	4½	4
4	10½ ft. (side)	252	120	6	6
5	14 ft. (side)	312	150	7½	7
6	17½ ft. (side)	372	180	9	8
7	21 ft. (side)	438	210	10½	10
8	24½ ft. (side)	498	240	12	11
9	28 ft. (side)	558	270	13½	12
10	31½ ft. (side)	624	300	15	14
11	35 ft. (side)	684	330	16½	15
12	38½ ft. (side)	744	360	18	16
13	40 ft.	810	390	19½	18
14	Entire 10x40 Cham.	870	420	21	19

It has been found convenient to use some of the standard furnace cements as a component of the mixture. These cements, generally speaking, are composed of varying proportions of clay such as flint or plastic clay, crushed fire-brick, some so-called ganister generally made up of quartzite, and small proportions of other minerals together with some sodium silicate as a binder. These prepared furnace cements are mixed in predetermined proportions with additional quantities of high-grade silica sand, sodium silicate, water, and small quantities of asbestos.

The mixture is prepared as follows: The furnace cements are first mixed thoroughly in a mortar box, using a hoe. The sand and asbestos are thoroughly mixed separate from the furnace cements, care being taken to make certain that all lumps in the asbestos are broken. The sand must be dry; otherwise it will form lumps with the asbestos. The sand and asbestos mixture is then incorporated with the cements and the water glass or technical sodium silicate added, and the whole is thoroughly mixed in the mortar box. Finally the required amount of water is added (approximately the amount shown in foregoing table) to obtain the desired consistency. Mixing in 100-lb. batches has been found to be convenient. This amount is sufficient to fill three standard size pails which are used as needed on the working platform in the chamber.

Each 100-lb. batch should cover approximately 100 sq.ft., ⅛ in. thick. The thickness of the coating should be not less than ⅛ in. and preferably not more than ¼ in. From ⅛ in. to $\frac{3}{16}$ in. is ideal. While the first batch is being sprayed, another similar batch is freshly prepared, thus producing a continuous operation.

A brushing solution is prepared as a finishing coat for the lining. The table above shows the necessary amounts of ingredients for one batch mixture, which will usually serve three batches or more of the lining mixture.

Spraying and Brushing—Before spraying, the openings of the residuum and liquid level lines are plugged. The spraying is accomplished by means of a cement gun, with about 80 lb. of air pressure in the line. If the mixture in the pail is too thick for spraying, only enough water is added to bring it to the desired consistency.

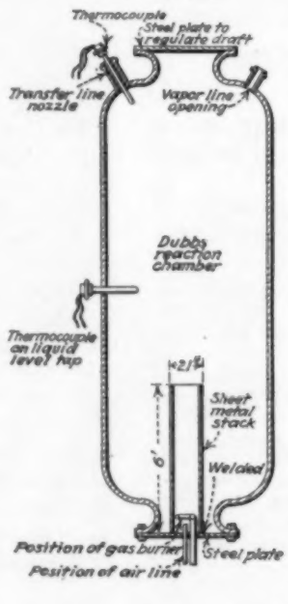
The dome of the chamber is sprayed first. During the spraying of the dome the man with the mixture stands back close to the wall of the chamber, holding the pail about 2 ft. from the top. After each pail is sprayed on, both men in the chamber brush the sprayed section with the brushing solution, checking the thickness with the finger nail or with a knife.

The brush for applying the brushing solution is only dampened or slightly wet with the solution, in order to avoid thinning the already applied coating. The time required to spray on one pailful permits sufficient setting of the applied coating and prevents, in a measure, dilution when applying the brushing solution. When the mixture is sprayed on thick, it is brushed down to the desired thickness or about ⅛ in. and when sprayed on too thin it is brushed over with a fresh mixture and then afterward brushed with the brushing solution.

The spray-gun operator positions himself approximately 4 to 5 ft. from the wall he is spraying and each section of the wall after spraying is checked for thickness and brushed with the brushing solution. After spraying the gun should be placed in a pail of water set on the platform and blown out, care being taken that this water is not discharged on the wall of the chamber.

If the coating dries too fast for easy brushing, somewhat more brushing solution is used on the brush and harder strokes applied, but generally speaking the amount of brushing solution should be reduced to a minimum. In spraying and brushing, special care should be taken to cover the area around and under the hooks. Before lowering the working platform for spraying the next section, the already sprayed area is carefully examined for open spots or irregularities and the thickness of the coating checked as described. To complete the lining the neck of the chamber is troweled and brushed.

Fig. 2—Reaction Chamber Arranged for Curing of Ceramic Coating



Curing Procedure—The curing equipment consists of a gas burner with an air jet and short sheet metal pipe for combustion space. The arrangement of this equipment is shown in Fig. 2.

Before curing, the lining is air-dried for at least 12 to 18 hours and an extra day of air drying has been found to be very beneficial. Precaution should be taken to keep rain from the coating during the period of drying. During cold

weather a closed steam coil should be installed in the bottom of the chamber and the temperature maintained at between 60 and 70 deg. F. so that the lining does not freeze during air drying. It is also important that the temperature be kept steady during the air-drying period to prevent the lining from cracking. After the air-drying period, the temperature of the chamber is gradually raised to 180 deg. F. and the following schedule maintained thereafter.

Temperature Schedule for Curing

Hr.	Deg. F.		Hr.	Deg. F.		Hr.	Deg. F.
1	180	Critical Range	6½	217		17	450
1½	185		7	220		18	500
2	190		8	225		19	550
2½	195		9	235		20	600
3	200		10	245		21	700
3½	202		11	260		22	800
4	205		12	280		23	900
4½	207		13	290		23½	900
5	210		14	330		24	Cut Fires
5½	212		15	360			
6	215		16	400			

With the proper draft, which is regulated by the steel plate at the top manhole, the difference in temperature between the thermocouples can be practically eliminated or made very small. The temperature increase per hour while any portion of the lining is within the 200 to 225 deg. range (critical range) should be maintained not to exceed 5 deg. the critical range the water comes off at the most rapid rate and it is very important that the slow rate outlined in the temperature schedule be followed closely so as to avoid overheating and consequent blistering of the lining. It is further advisable, if there is a difference in temperature between thermocouples, that the thermocouple registering the highest temperature be used until it has reached 225 deg., and then the slow rate continued using the thermocouple registering the lowest temperature until the 225 deg. temperature on that thermocouple also is reached. This should be done to avoid overheating any portion of the lining during the critical range. It is further advisable to cure at a slow rate, as this gives a smoother surface.

Tests are being planned at the present time to cure the lining by means of heating ovens. The plan is to insert the whole chamber in a heating oven and follow through the regular schedule. This plan, of course, is feasible for centralized manufacture only. Curing in this manner will permit exact temperature control and eliminate excess carbon dioxide, which has a deleterious effect on the lining while curing is taking place.

Patching—If blisters are formed which are easily cracked, or if there are defective areas after curing, the lining should be knocked off and the metal cleaned thoroughly with a wire brush. The mixture is applied to the patches by troweling a heavy standard mixture, and cured. If the defective area is large, repatching and curing should be done in the same manner as for the original installation. The method of curing areas that have been patched is the same as used for curing the entire chamber. The same schedule for increasing the temperature should be followed.

Properties—The coating possesses all of the properties which have been previously enumerated as desirable. It is hard and in cross-section appears to be a mineral aggregate with the silica sand quite prominent. It is difficult, if not impossible, for a man of average strength to break a square inch section of the removed lining. The lining is resistant to hammer or chisel blows of considerable violence.

A large number of reaction chambers, dephlegmators, and other vessels have been lined with satisfactory results; some of these linings have been in for approximately a year and apparently have improved with age. Usually, with the present method of curing, the inside walls of the chamber are in better condition than the dome.

From a general knowledge of the reactions of sodium silicate, it may be concluded that no, or at most only a slight, chemical reaction takes place with the other mineral components. There may be a surface film reaction between the sodium silicate and the grains of quartz in which the binding action is somewhat more than adhesion, but generally speaking it can be assumed that the dehydrated sodium silicate plus the natural refractory-forming properties of the plastic clays and other materials cause the formation of the integrated mass.

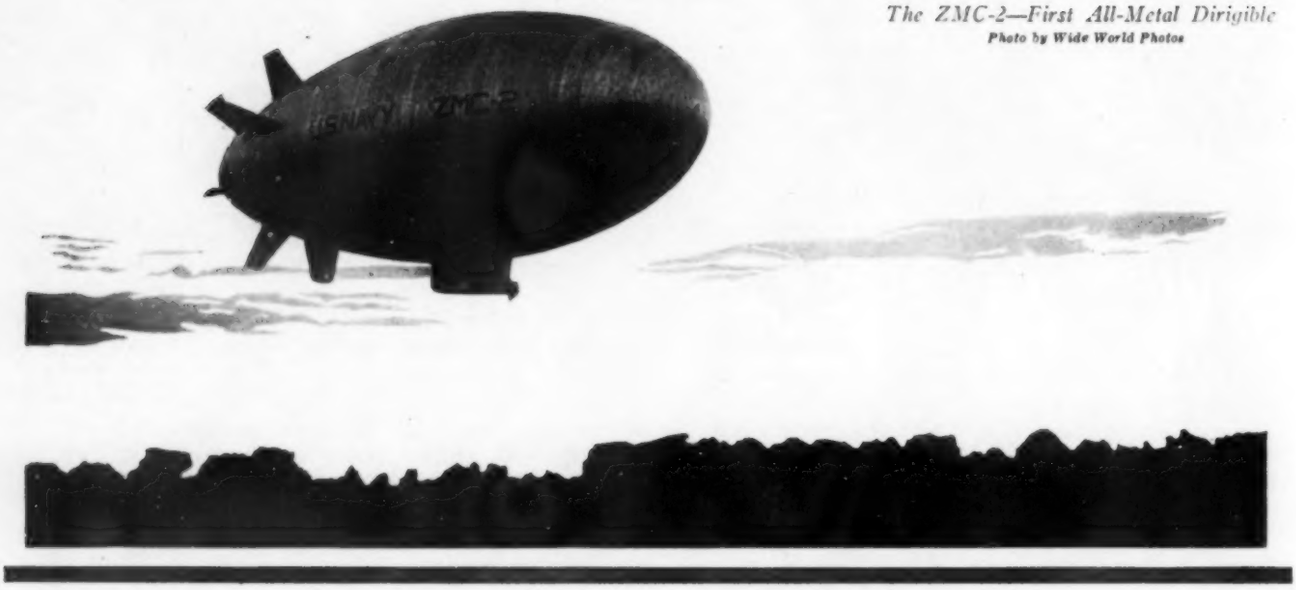
Other applications—A series of tests made with sulphuric acid of various concentrations from 10 to 95 per cent and with sodium hydroxide solution from 5 to 25 per cent shows that the material is quite resistant to the action of acids and alkalis. In connection with the acid tests, there was an actual increase in the weight of the sample, showing the formation of a surface film of silicic acid, but in none of the tests was the material weakened to any observable extent.

It is contemplated applying the protective coating to other forms of equipment, such as for protection of oil-treating plants, particularly the acid settling chambers and reaction vessels (for example, where nitration, sulfonation, halogenation, and acid or alkaline reactions are carried on), coating of smoke stacks, conduits, transfer lines, and in general wherever metal surfaces require protection against corrosion.

Scrubbing Organic Gases With Active Charcoal

ACTIVE charcoal has appeared to advantage in comparison with paraffine oil as an agent for removing vapors of organic liquids from gas mixtures. The applicability of active charcoal to difficult recovery problems is such that it is being successfully used for separation of benzol from coal gas, gasoline from natural gas, ether, acetone and alcohol from effluent gases from celluloid and film manufacture, and solvents from rubber processing vapors. It is a peculiar property of active charcoal that many specimens are active catalysts of gas reactions. There is no apparent relation between adsorption efficiency and catalytic activity; some specimens are active in both respects, and some much more in one than the other.

These experimental results, described by W. Kärsten in *Teer und Bitumen* recently, show a clear superiority of adsorption over absorption as a means of solvent recovery, particularly in the low concentration ranges which are important commercially. Adsorption has the further advantages that the solvent or liquid is recovered in a purer state than by absorption, and that reactivation of active charcoal is cheaper than the purification of spent paraffine or scrubbing oil. Large-scale applications are cited where active charcoal is used in the recovery of gasoline from natural gas, and of benzol from coal gas. The principles to be followed hold equally for recovery of volatile solvent vapors in the process industries.



The ZMC-2—First All-Metal Dirigible
Photo by Wide World Photos

Contributions to Aviation

Feature Meeting of

ELECTROCHEMICAL SOCIETY

Editorial Staff Report

WITH a total attendance of approximately 400 the American Electrochemical Society held a most successful three-day meeting at Pittsburgh. It was the 56th convention of the Society and a full and elaborate program was provided. The main session, devoted to a symposium on the contributions of electrochemistry to aeronautics, and the other technical sessions, were supplemented by attractive social function and visits to industrial plants. The trip to the Westinghouse Electric and Manufacturing Company's works at East Pittsburgh proved to be particularly interesting.

A large number of aeronautical engineers and men prominent in aviation attended the opening session which was admirably well planned and carried through, with J. D. Edwards of the Aluminum Company of America presiding. The subject was very opportune in view of the recent epoch-making flight of the first all-metal airship, ZMC-2, built almost entirely of aluminum. The gas bag is of Alclad sheet, riveted in strips 18 inches wide and 0.0095 inches thick. C. B. Fritsche of the Detroit Aircraft Corporation described in detail, with the aid of four reels of film, the building of this remarkable airship.

Nine other papers were presented at this aeronautics session. T. W. Bossert of the Aluminum Company described the various light aluminum alloys, notably Duralumin, which contains, besides Fe and Si, small percentages of Cu, Mg and Mn. The alloy is relatively soft and workable immediately after heat treatment, but hardens or ages during the four days following quenching. Another aluminum alloy, Alclad metal, of particular interest because of its makeup and also because of its corrosion resisting properties was described. It is a composite sheet whose strong Duralumin core is covered on either side with a sheath of very pure aluminum. The outer pure aluminum is decidedly more resistant to corrosion than the strong aluminum alloys. However, as Dr. Edwards and C. S. Taylor in their paper on "Solution Potentials of Aluminum Alloys" pointed out, when corrosion does occur, as for example at the exposed edges of the duplex metal sheet, it is at the expense of the protective aluminum coating and not of the alloy core. The pure aluminum is anodic to the Duralumin core by as much as 0.1 to 0.2 volt, which apparently is sufficient under the circumstances to protect the core from the intergranular type of corrosion, to which certain of the heat-treated, strong aluminum alloys are subject.

W. G. Harvey of the Aluminum Company reported on the present status of "Magnesium and its Alloys in Aircraft" and put on display a number of large, mechanically perfect castings of magnesium containing a little manganese. Due to its inherent chemical and mechanical characteristics, it has been difficult to work the metal into useful shapes. However, recently, through the discovery of methods of purification of the metal and of the methods of heat-treatment of magnesium alloys, most fabricating obstacles have been overcome. Today magnesium alloy castings are made possessing mechanical properties substantially equal to the best of the high-strength aluminum alloys. Through careful purification of the magnesium metal and alloying this with certain metals, such as manganese, alloys have been developed which show remarkable resistance to corrosion. The making of magnesium forgings has just emerged from the experimental stage. The forgings possess comparatively high mechanical strength. Forged magnesium propeller blades can be produced with weights not differing materially from those obtained with wood.

The possible use of "beryllium" in aircraft construction was discussed by H. W. Gillett of the Battelle Memorial Institute. Beryllium is more abundant in the earth's crust than either lead or zinc. The outstanding property of this metal is its high modulus of elasticity.

Edward P. Warner, editor of *Aviation*, referred to the new dignity that aircraft is attaining. The light metals, produced by the electrochemist, are still rivaled by wood in the field of aeronautics but the consumption of metal is now on the up grade. Very often there is no difference in strength or weight of material between wood and metal, but as a matter of economy metal is chosen. However, the cost of material is relatively unimportant.

George W. Louis, director of the National Advisory Committee for Aeronautics, called on the electrochemists to produce a very light metal which would be very resistant to corrosion. The carrying weight or pay load is today 20 to 50 per cent of the total weight of the craft. Starr Truscott, assistant director of the Committee, pointed out that the choice of material for aircraft construction was due largely to the greater "factor of ignorance" with wood than with metal. He suggested a more careful investigation of chromium-plated copper. Harold Work referred briefly to the successful plating of aluminum with chromium.

One subject that continued to come up throughout the discussion of the papers presented before the aeronautics session was that of corrosion and how to combat it. F. N. Speller emphasized the effect of strain on the corrosion rate. E. F. Cone referred to the protection of steel with aluminum. Nevertheless, most engineers present felt confident that the time was not remote when metal parts for aeroplanes and airships would be produced that would be resistant not only to corrosion but to erosion and prolonged strain.

THERE were two sessions on September 20. The electrothermic division presided over by Harry M. St. John, was mainly concerned with the annealing of non-ferrous metals. The other session, presided over by President Francis C. Frary, included papers on the Weston standard cell, overvoltage, pure iron, analysis of carbon and iron, and corrosion.

M. deKay Thompson and R. B. Atkinson, of Massachusetts Institute of Technology, demonstrated that, by determining the electrical conductivity and temperature of the solution in any part in the circulating refrigerating system, the composition of mixtures up to 50 per cent ammonia at 15 deg. C. could be determined to 0.5 per cent or better. As the temperature falls, the conductivity changes less and less with the composition so that –30 deg. C. solutions containing more than 32 per cent ammonia could not be analyzed by this means.

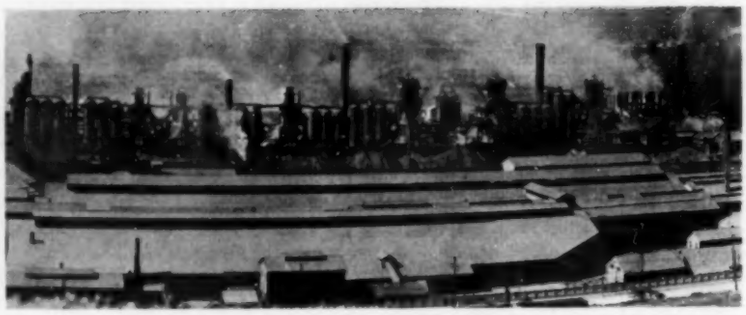
CORROSION of ferro-nickel was studied by C. G. Fink and C. M. Decroly of Columbia University. In the chemical engineering industry there has been an increasing demand for special alloys resistant to various electrical reagents. The authors record tests made on commercial alloys of the iron-nickel series, using the intermittent corrosion test, as this more nearly approaches actual service conditions. Specifications laid down by the American Society for Testing Materials were followed as closely as possible. Results in general indicate that the rate of corrosion in sulphuric acid increases at first very rapidly with the concentration of the acid, reaches a maximum, then decreases again, reaching a minimum, and usually increases again to reach a second maximum. The addition of small percentages of chromium to the alloy, for example, up to about 4 per cent, does not materially alter the general trend of the nickel-iron curves. However, higher percentages, such as we find in nichrome, with 12.5 per cent chromium, tend to eliminate the first sharp rise in the corrosion rate. Nor is there in these high chromium alloys a distinct minimum to be detected. On the other hand, other alloys quite distinct in composition from the ferro-nickel alloys, such as the commercial copper alloy Barberite, composed of copper with a little nickel, tin, and silicon, give the same type of corrosion rate curve as the ferro-nickel alloys. The addition of chromic acid to the sulphuric acid does not render the surface of the nickel-iron alloys passive, but, on the contrary, accelerates the corrosion. Contact potential measurements, made with the different samples of ferro-nickel alloys, show a relation between voltage and acid concentration somewhat similar to the corrosion rate relation, but in other respects are more or less distinct, indicating that the rate of corrosion is primarily dependent upon the rate of oxidation by the oxygen dissolved in the sulphuric acid, and not by the rate of ionization of the metal.

E. M. Baker of the University of Michigan discussed at length an investigation that he, together with A. J. Herzig and R. M. Parke, had carried out to determine the protective value of coatings on steel of the iron-phosphate type. These coatings are often used in place of certain electroplated coatings and were produced on mild steel from solutions containing various concentrations of iron phosphate and phosphoric acid.

Of the two sessions on Saturday, the electro-deposition session, in charge of Charles L. Mantell, comprised nine papers covering the deposition of Ni, Cr and Cu. Much of the discussion was centered about the best methods for the control of the sulphate in chromic acid baths and simple methods for the determination of the hardness of the chromium deposit. H. S. Lukens of the University of Pennsylvania described a research that he, together with Lester W. Strock, had carried out on the use of tantalum in place of platinum in Cu determinations. Observing the simple precaution of using a very high current density of 3 amp./sq.dm.,

tantalum can be successfully used in place of platinum. There is a tendency of the tantalum to form an oxide film which, if formed, must be removed with an abrasive to insure good adhesion and concordantly good results.

A session devoted entirely to electro-organic chemistry, presided over by President Frary, emphasized the rapidly increasing importance of this field of electro-chemistry. Chemists and engineers are beginning to appreciate more and more the decided advantages of electrolytic processes over the old chemical processes, such as ease of control in the output of well defined products.



Edgar Thomson Plant of Carnegie Steel Company, One of Pioneers in Utilizing Electric Processes, Was Visited by Electrochemists in September

In the electrolytic preparation of 2-4 diaminophenol, W. E. Bradt and O. W. Brown of Indiana University obtained a maximum material yield of 94.4 per cent. The reductions of the nitro-compound were conducted in open and closed electrolytic cells. The yield was determined by diazotization of the amine with standard sodium-nitrite solution. Cathodes of Zn, Cu and Pb were tried out, the best results being obtained with Cu. The anode was sheet lead and the cathode current density was one amp. per sq.dm.

Robert E. McClure and Alexander Lowy of the University of Pittsburgh prepared phenylhydrazine by the electrochemical reduction of certain benzenediazonium compounds.

Sherlock Swann, Jr., of the University of Illinois, electrolyzed diethyl acetic acid and methyl propyl acetic acid and found that the Kolbe synthesis of hydrocarbons does not take place with either of the acids studied. However, the investigation is being continued.

Fr. Fichter, of the University of Basel, submitted a report on his investigation of the Kolbe electrosynthesis. He finds that the electrosynthesis may be duplicated by powerful chemical oxidizing agents like fluorine. If fluorine or persulphate act in an alkaline solution on a salt of a fatty acid, it is possible to duplicate the electrolytic production of alcohols developed by Hofer and Moest.

Alexander Lowy, together with C. H. Rasch, of the University of Pittsburgh, demonstrated the application of his new grid-plate electrode in the electrochemical oxidation of anthracene to anthraquinone. The new electrode has a solid organic depolarizer in contact with the electrode material at which the electrochemical action is to take place. The base or framework of the electrode is of metal, which supports the oxide of the metal intimately mixed with the organic depolarizer. Experimental work was conducted to oxidize anthracene to anthraquinone by using a lead grid filled with a mixture of lead dioxide and anthracene as the anode. It has been found that the new type electrode gave a much greater yield and current efficiency than where the depolarizer was suspended in the electrolyte. This principle is recommended with other electrode combinations for organic electrolytic reductions and oxidations.

R. W. Mitchell, of the Magnus Chemical Company, Garwood, N. J., demonstrated that toluene can be electrochemically oxidized in the presence of catalyzers, notably manganese sulphate and chromium sulphate. He used a lead-dioxide anode and toluene was oxidized to benzaldehyde in the case of manganese and to benzoic acid in the case of chromium sulphate. By continually removing the mulsified toluene from the electrolytic cell which is forming manganese sulphate and chromic acid and extracting the oxidation products from the toluene and then returning the toluene to the cell, a very efficient method for oxidizing toluene electrochemically to benzaldehyde and benzoic acid respectively is outlined.

AMONG the various industrial plants visited by the members of the Society were the Westinghouse Electric & Manufacturing Company, the Arnold Plant of the Aluminum Company of America, Edgar Thomson Works of the Carnegie Steel Company, Colfax Power Station and the Firth-Sterling Steel Company.

At the dinner held at the William Penn Hotel on the evening of September 20 the Society's medal was formally awarded to Edward Goodrich Acheson. This is the highest honor the Society has bestowed upon any man, and it was in recognition of the basic accomplishments of the medallist. President Frary very fittingly alluded to the early years when Dr. Acheson had heated a mixture of sand and coke in an electric furnace to very high temperature and obtained beautiful iridescent crystals almost as hard as diamonds. He had the vision to see these carborundum crystals transformed into useful objects, and the perseverance to give reality to his vision and spread the use of the hard material over the world.—In this first classical experiment some parts of Dr. Acheson's furnace got too hot after the carborundum crystals had been formed and they were spoiled. Instead of the shiny, hard carborundum crystals, there were only black, unctuous pieces of graphite. Dr. Acheson immediately realized that here was the nucleus of a method for making graphite artificially, and of controlled quality and quantity. Now, these two products are a conspicuous monument to one of the first men to make electrochemistry a factor in the present industrial world.

Firth-Sterling Steel Company, McKeesport, Pa.; One of Interesting Visiting Points at A.C.S. Meeting

T.A.P.P.I. Holds Fall Meeting In Richmond

ABOUT 300 paper mill executives, superintendents, engineers and chemists attended the annual fall meeting of the Technical Association of the Pulp and Paper Industry, held at the Jefferson Hotel, Richmond, Va., on Sept. 24 to 26 and in Washington, D. C., on Sept. 27.

Paper-making patents featured the first day's meeting. Charles W. Rivise, patent attorney of Philadelphia, Pa., read a paper entitled "What is Patentable in Paper Making." Mr. Rivise indicated the various factors of patentability, showing the difference between discovery and invention. He pointed out that making an old device portable, making minor, unimportant adjustments and the like are not patentable.

J. D. Miller, of the York Haven Paper Company, York Haven, Pa., reported the work being carried on by the committee on corrosion. A recent survey indicated that the majority of the paper and pulp mills are giving close attention to corrosion problems and are in need of help to cut down the great loss from this cause. Mr. Miller's committee is making a special study of the new alloys that are being offered to the industry. These alloys are being subjected particularly to the conditions inside of the sulphite digesters. It is quite likely that the time is rapidly approaching when the materials for digester construction will be such as to make brickwork lining unnecessary.

Clark C. Heritage, of the Oxford Paper Company, Rumford, Me., read a paper entitled "The Measure of the Strength and Stiffness of Fiber Board by Means of Static Bending." The work done to prepare this paper is interesting because it is symbolic of a new approach to the paper and board testing problem which has been done in an empirical way heretofore, and may now be handled in the same way as the structural properties of other solid materials are treated, namely by use of the stress-strain diagram for a beam consisting of the sheet of paper board to be tested.

ON JULY 1 the Technical Association in co-operation with the American Paper and Pulp Association established a fellowship at the Forest Products Laboratory, Madison, Wis., to study some of the more fundamental problems relating to paper making. The status of the fellowship project was given by R. H. Stevens of the Bogalusa Paper Company of Bogalusa, La., and C. C. Heritage. Randal H. Doughty has been appointed to carry on the work. Following a complete statistical and mathematical analysis of the data available from previous work, experimentation will be carried on to study the relation between the structural strength of the sheet and its solid volume fraction. It is quite possible that we may eventually be able to anticipate the physical properties of pulp or paper in sheet form by an examination of the fibers in suspension prior to having them made into sheet.

Pulp evaluation was the subject of a symposium on Wednesday morning. D. E. Cable, of the Oxford Paper Company, presided as chairman and three papers were read on the subject of strength-testing of pulp. These included a paper by H. A. Rothchild, of the Kimberly-Clark Company, Neenah, Wis.: "The Beater Method of Evaluating Pulp"; a paper by J. E. O'Connell of Lake St. John Pulp and Paper Company, Dolbeau, Quebec, on "Estimating Pulp Quality"; and one by Harry Bradford, of the Rex Paper Company, Kalamazoo, Mich., on "Strength Tests for Pulp."

Dr. Cable indicated that the committee on physical standards has been active during the current year and has recently published a thorough review of the literature of pulp testing which was prepared by W. F. Moore, of the U. S. Testing Company, New York. It is expected that, as a result of the concentrated effort that is now being made internationally to solve the pulp-strength testing problem, two standard methods will be evolved, one for quick plant control and a very accurate method for establishing pulp standards for use in the various mills.

A paper standards symposium was directed by B. W. Scribner, chief of the paper section of the U. S. Bureau of Standards. Two papers were contributed to this meeting as follows: "Paper Standards," by F. T. Carson, and "Equipment and Researches of the Bureau of Standards Paper Mill," by Merle B. Shaw. Both of these men are connected with the Bureau and the papers were read to prepare the members of the association for their visit to the Bureau.

FOLLOWING this symposium another was devoted to shrinkage or the accounting for all of the materials entering the paper making process. Some mills have losses in excess of 10 per cent and it is only recently that the losses have been realized and diminished. A. T. Taylor, of the Bedford Pulp & Paper Company, Big Island, Va., read a paper entitled "Shrinkage," showing that in his mill a maximum shrinkage of 12.2 per cent was experienced with papers consisting of 60 per cent groundwood, 20 per cent overissues of magazines, and 20 per cent sulphite pulp. White paper made entirely of sulphate or kraft suffered only 1.9 per cent loss or shrinkage. Donald K. Pattillo, of the National Alluminate Corporation, read a paper on "Shrinkage Reduction" and showed how chemical methods, including chlorination, prevent loss of fibers that would otherwise disintegrate and form slime.

Other papers read included the following: "Roll Winder Development," by James A. Cameron, of Brooklyn, N. Y.; "Modern Recovery Practice in Sulphate and Soda Mills," by C. L. Wagner, of New York; "A New Sectional Speed Regulator for Sectional Paper Machine Drive," by R. R. Baker, of East Pittsburgh, Pa., and "Recent Developments in Domestic Clays for Coating and Loading," by O. W. Callighan, of Metuchen, N. J.

On the afternoons of the three days spent in Richmond the members made visits to the following mills: Standard Paper Manufacturing Company, Albemarle Paper Manufacturing Company and Manchester Paper Board Company, all of Richmond, Va.; the Hummel-Ross Fibre Corporation, of Hopewell, Va., and the Chesapeake Corporation, in West Point, Va. Following the sessions in Richmond, one day was spent in Washington, D. C., where a visit was made to the District of Columbia Paper Manufacturing Company's mill where soda pulp is made from pine and blended with half stuff from cotton linters to make blotting paper, cover stock, etc. Several hours were spent in the Paper Section of the Bureau of Standards, where a special demonstration of all the equipment and instruments in use was given. Following this tour of inspection lunch was served at the Government Printing Office, after which the many departments of this huge plant were inspected.

Modern Drives Turn Wheels of Chemical Plant Equipment

By William Staniar
Mechanical Power Engineer
E. I. du Pont de Nemours & Company, Wilmington, Del.

PREVIOUS to the World War there was less activity in the chemical industry than there is today; therefore the driving of chemical engineering equipment was no great problem then because the apparatus was of simpler construction, plenty of space was available, and production demand was moderate. At that time nearly all this apparatus was driven by belting or ordinary systems of gearing. Mixing vats, agitators, screens, dryers, grinders, and all such equipment, were easily propelled by systems of belting, shafting, and gearing because accuracy of speed and the time element were not so essential. Fire and safety hazards were not so conspicuous and little thought was given to the possibility of such hazards as belt static and possible injury to employees. Today *safety* is paramount to all manufacturing establishments, and the danger of chemical fume ignition by static electricity from transmission belting is so apparent that this medium, by compulsion, has been eliminated in a large number of instances.

The majority of industrial chemical equipment is operated under what is known as the "closed system". Even with this precaution, flammable and explosive vapors are at times in evidence in areas surrounding and adjacent to such apparatus, causing fire and explosion hazards when belting is the power-transmission medium.

According to research work carried on in the laboratories of the U. S. Department of Agriculture, static electricity of high voltage can be generated on a moving power belt. The charges may be built up by one or all of three methods: friction of the belt on the pulley, the separation of the belt from the pulley, and by friction of the atmosphere on the belt. The principal source of friction, however, is the separation of the belt from the pulley. Under certain conditions, wherever two dissimilar materials that have been in contact are separated, a static charge is produced on each object. Because of continual separation between belt and pulley, charges are generated on each. The pulley can be grounded, but the belt, usually a non-conductor, allows the potential to build up under some circumstances until sparking occurs.

The development of power transmission methods has of necessity kept pace with the steady advance and increasing complexity of chemical plant equipment. Primarily, this has been brought about by the dangers of static electricity from belting in the presence of flammable vapors, and the inability of this medium of transmission to give the required accuracy of speed on certain types of apparatus.

Practically all modern chemical equipment, such as high- and low-pressure mixing vessels, dryers, high-speed pulverizers, attrition mills and so on, must be driven. And usually, owing to the complication of the process involved, the available space for transmission purposes is small. Frequently the reduction ratio from power source to application is high. Speed of rotation must change instantly and must be graduated into fractions of a revolution. These are the exacting demands made on power transmission mediums by the modern chemical manufacturing plant. It is obvious that belting, shafting, pulleys, and ordinary open gearing can play only a small part in such transference of power.

Based on the parallel development of both processes and drives and the activity and foresight of mechanical power machinery manufacturers, there are today available compact, efficient transmission mechanisms to meet the most exacting demands of chemical apparatus driving. The problems of high ratios, short centers, variable speeds and rotation at fractions of a revolution are no longer insurmountable where space is at a premium and

Fig. 1—Modern Horizontal-Drive, High-Ratio Reduction Gear Direct-Connected to Integrally Mounted Motor

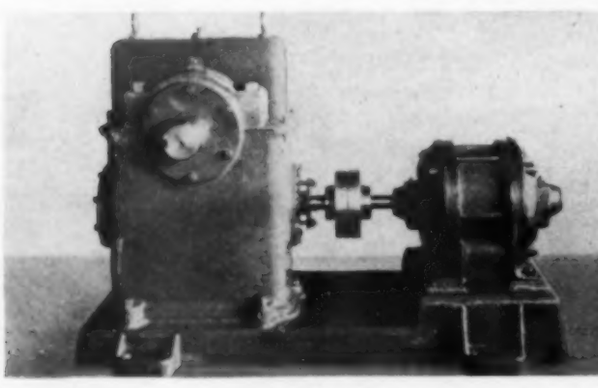
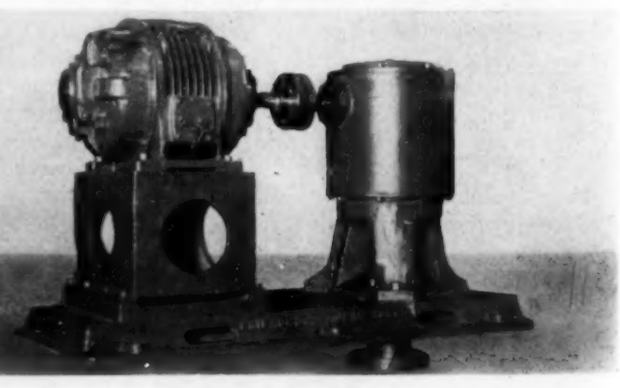


Fig. 2—Vertical-Drive Reduction Gear of High Ratio of a Type Frequently Used With Kettles and Autoclaves



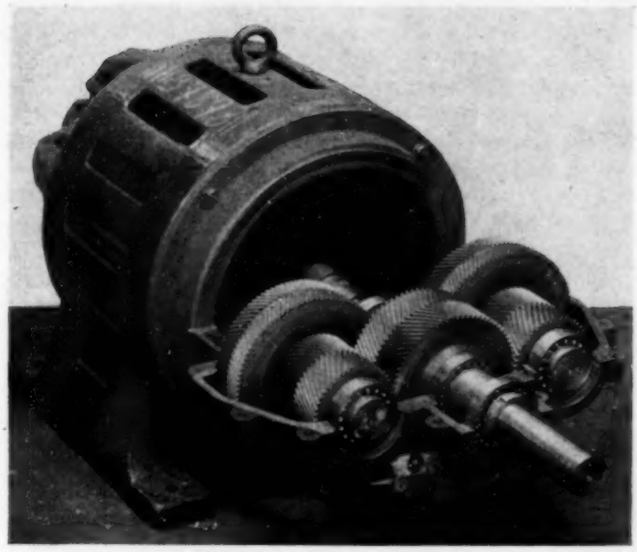
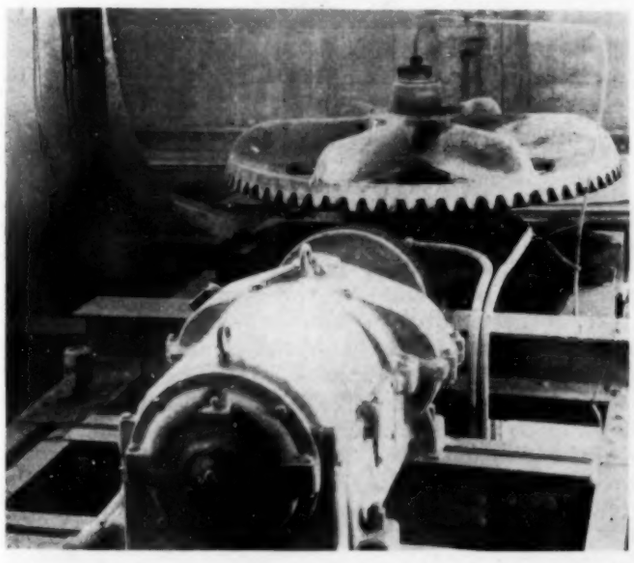


Fig. 3—Integral Reduction Gears of Newly Developed Helical-Geared Motor

corrosive and flammable vapors exist. In the past ratios of 25 and 50 to 1 were considered high and were solved by a multiplicity of shafting, belting, and pulleys, but now ratios of 100 and 500 to 1 are common and are solved by compact gear reduction units such as those shown in Figs. 1, 2, and 3. Figs. 1 and 2 are modern high-ratio reduction gears flexibly coupled to their motors and supported integrally on a single base plate. Fig. 3 illustrates one of the latest developments of speed reduction. The motor and reduction gear are one compact machine. This is known as a helical-geared motor. Actual installations of some of these types of apparatus driving chemical equipment are shown in several views. Fig. 4 illustrates a 20-hp. helical-geared motor direct-connected through bevel gearing to a large calcining kettle running at 18 r.p.m. Fig. 5 illustrates the compact driving of large revolving drums by the direct-connected vertical worm-gear reduction unit. A drive for this purpose would require considerable space and large amounts of shafting and belting if the drums were

Fig. 4—20-Hp. Helical-Geared Motor Direct-Connected to Gypsum Calcining Kettle Drive for 18 R.P.M. at the Kettle



driven by the old methods, and the belting would be subjected to severe corrosive fumes.

Compact driving through the aid of a direct-connected reduction gear and spur gears of a rotary kiln is illustrated in Fig. 6 while Fig. 7 shows an extremely modern compact transmission installation—an integral unit composed of high-speed motor, worm reduction gear, and centrifugal pump.

The types of modern worm-gear reduction units shown have been perfected to such an extent that all previous notions as to their inefficiency have been made invalid. Hence they are used extensively in all classes of accurate chemical-equipment driving. A few years ago this method was in disrepute because it had not been recognized that the efficiency of worm gearing was entirely dependent on the helix angle of the thread of the worm. It is now a known fact that the greater the helix angle (up to about 42 deg.) the greater the efficiency; and the smaller the angle the greater the power loss.

In the cheaper grades of reduction units less attention is paid to the helix angle, and the result is a less efficient mechanism. To cover up this defect a large and

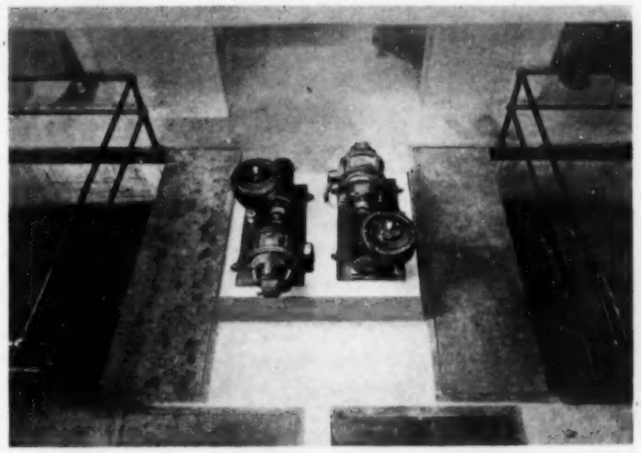


Fig. 5—Vertical Worm-Gear Reduction Units Driving Large Horizontal Drums

heavy casing ordinarily is provided so that the power loss, manifesting itself in heat, can be easily dissipated.

The accuracy of speed and the efficiency of modern worm-gear reduction units is obtainable because the worm usually is integral with an alloy steel shaft with threads hardened and ground. This combination is rigidly supported on ball or roller bearings, the rear bearing being of the double-row maximum type, capable of carrying the full thrust load of the worm in either direction, as well as one-half the radial load. The other half of the radial load is taken by the forward bearing.

The worm gear usually consists of a chilled cast-bronze rim shrunk on and pinned to a high-grade cast-iron center. The gears are absolutely true in balance and have their teeth accurately generated to conform to the helix angle of the worm. The housing usually is of cast iron designed in such a manner as to be compact, oil-tight, and of ample proportions for the power requirements.

The modern single-worm-gear reduction unit should not be used for ratios over 70 or 80 to 1. Higher ratios up to 5,000 and 10,000 to 1 can be obtained by the use of the double worm-gear reducer or by coupling two single reducers in tandem.

The modern worm-gear reducer delivers its power at

right angles to the power input, but in many installations, as applied to the driving of chemical apparatus, this is not feasible, necessitating the use of the spur gear reduction unit which reduces in a straight line.

An advantage of the spur gear reduction unit is the fact that ratios from 1 to 1 to 500 to 1 are obtainable in one casing. The 500-to-1 type, which is known as the non-planetary system, usually consists of spur gears radially disposed about a center pinion. Each of the spur gears is keyed direct to pinions which in turn mesh

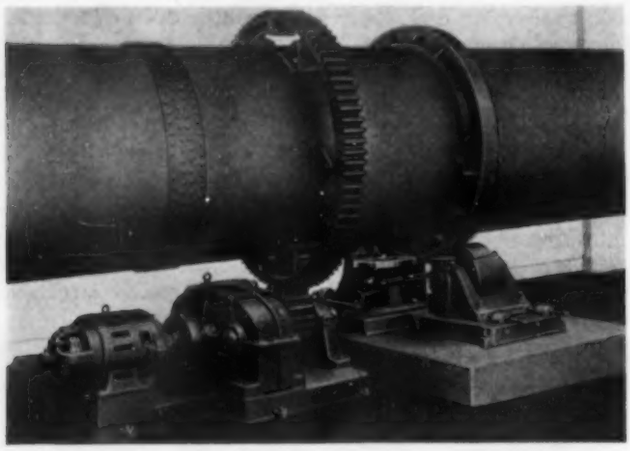
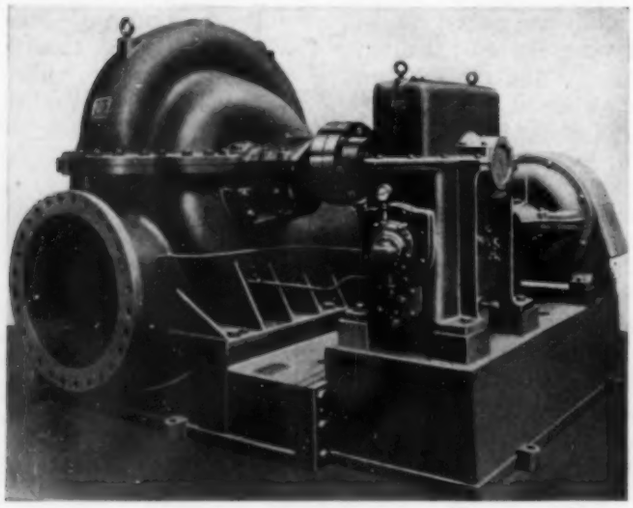


Fig. 6—Modern Cement Kilns and Rotary Dryers Employ Direct-Connected Spur-Geared Reducers of This Type

with a central gear mounted upon the slow-speed shaft.

In the driving of modern chemical apparatus it frequently is necessary for the final speed to be in fractions of a revolution with the prime mover operating at speeds from 1,200 to 1,800 r.p.m. One modern drive for obtaining such high ratios with a compact integral unit is composed of a 2-hp. motor, having a variable speed of 500 to 2,000 r.p.m., flexibly coupled to a spur-gear reduction unit. The latter in turn is coupled to a worm-gear reduction unit by a mechanical overload release or "let-go" device which automatically disengages in case of an extreme overload. (Overloading on modern direct connection should always be taken into consideration because of the rigidity of the entire mechanism.) The slow-speed shaft of the worm reducer is open geared to

Fig. 7—This Compact Unit Consists of High-Speed Motor, Low-Speed Centrifugal Pump and Direct-Connected Worm Reducer



the final application with a ratio of 4.15 to 1, giving a total ratio from motor to application of 9,560 to 1. With the variable motor speed of 500 to 2,000 r.p.m., this gives a variable application speed of 0.052 to 0.208 r.p.m.

This tremendous speed reduction is accomplished in a space no larger than that required for two ordinary belt drives and would be impossible if attempted by the belting and shafting method of speed transference because of the prohibitive space requirement and the inaccuracy of the final speed application.

It occasionally happens that the chemical engineer is confronted with the necessity of having two or more definite speeds of mixing or agitation during the cycle of some chemical reaction. These speeds must be under instant control and with no possibility of overflow from one speed to another. Otherwise serious results, if not disaster itself, may occur.

Based on the parallel progress of transmission mechanisms with chemical demand this is readily accomplished by what is known as the "mechanical ratio transformer," a device which can be flexibly coupled in series with a prime mover and either a vertically or horizontally connected gear-reduction unit. Such a transformer is controlled by a hand lever and is very similar in construction to the change-gear system of the ordinary automobile.

One typical installation of a "ratio transformer" coupled between a motor and a vertical worm-gear reduction unit driving a vertical agitator is equipped with three ratios, 1 to 1, 1.47 to 1, and 2.75 to 1. When operating on a 1-to-1 ratio, the net reduction from motor to shaft of agitator is 21 to 1, which is the ratio of the worm-gear reducer; when operating on 1.47 to 1 the net reduction is 30.8 to 1; and when operating on 2.75 to 1 the actual reduction of speed between motor and

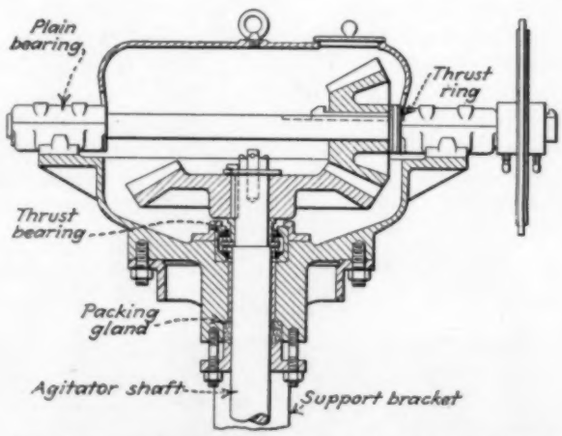


Fig. 8—Modern Inclosed Agitator Drive Unit With Cut Gears Shown in Section

final application is 57.75 to 1. In this case the motor is 20 hp. at 1,150 r.p.m.

Many agitating or mixing vessels must be driven at speeds that necessitate the employment of bevel gears direct-connected to the vertical or horizontal shaft. The vertical agitator or mixing vessel is the most common, and when bevel-gear-propelled, the gear usually is mounted on the vertical shaft and the pinion on a horizontal shaft immediately adjacent to the center line of the top of the tank. This shaft is then driven either by chain or belt from a group line shaft.

Before smooth and accurate speeds were necessary such bevel gears were of cast-tooth construction and

operated without a covering, employing thick grease as a lubricant. The modern agitator or mixer employs accurately cut toothed gears supplied with thrust mediums and incased in a cast-iron or steel oil-retaining housing as shown in Fig. 8. Such an installation insures positive lubrication and therefore silent and smooth running gears. The horizontal high-pressure slow-speed agitating vessel in the chemical industry presented a difficult problem of driving prior to the advent of the modern reduction gear. It frequently occurs that such apparatus is installed in groups of two or more, and the power required for each vessel of the group ranges from 20 to 30 hp. By the old methods of driving it would be necessary to employ several sets of bevel or miter gears, large-diameter line shafting, and a multiplicity of counter and jack shafts to reduce the speed from the prime mover. The driving of such apparatus is now comparatively easy because of the existence of the combined

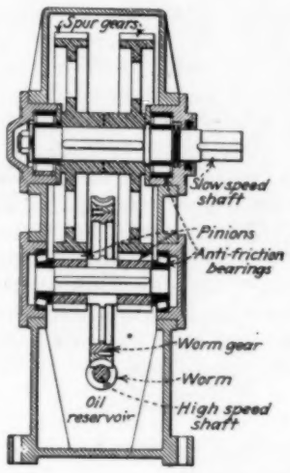


Fig. 9—Newly Developed Combined Worm and Helical-Gear Reduction Unit

worm- and helical-gear reduction unit which can be coupled individually between the motor and each horizontal vessel of the group. A reduction unit of this type is shown in section in Fig. 9. This particular unit is capable of handling a continuous steady load of 25 hp.

The foregoing discussion has dealt chiefly with the solving of high ratios and definite set speeds by modern gear mechanisms. In addition to these problems it frequently occurs in the chemical industry that minute variations of speed are necessary during operation and without hindering the chemical reaction taking place. The variable-speed motor, with the exception of one of special design, is not applicable for installations such as these because it possesses only a certain definite range of speed variations. Therefore, manufacturers of power-transmission mediums have developed what is known as the "mechanical speed transformer." This machine consists essentially of two parallel shafts mounted in a rigid frame, each of which carries a pair of cone-shaped disks with their apexes facing inward so as to form together a spool-shaped pulley. An endless belt, wedge shaped in cross-section, passes around the two spool-shaped pulleys formed by the two pairs of disks. The wrap of the belt about these pulleys is dependent upon the separation of the component disks. This is controlled at will by the operator, one pair increasing in separation by an amount equal to the decrease of the second pair upon adjustment.

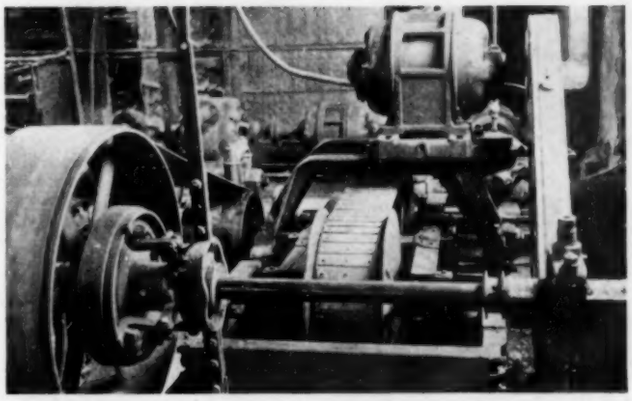


Fig. 10—Mechanical Speed Transformer Driving Board Machine; This Type of Device Gives an Infinite Number of Speed Ratios

It is evident that the sidewise movement of these disks makes possible an infinite number of different ratios over the speed range of the device, which may be as high as 16 to 1. A typical installation of this type of device driving a board machine is shown in Fig. 10. It will be noted that the motor is connected by silent chain to the constant-speed shaft of the drive and supported integrally with the unit. The variable-speed shaft is belt-connected to the pulley of the driven apparatus and controlled by a clutch.

Close connection between prime mover and power application does not necessarily mean that all such cases demand high ratios of speed increase or decrease. Many instances occur where short center distances are imperative, but the ratios required range from 1–1 to 8–1. Gear-reduction units of any type are not always practicable for such ratios regardless of the compactness desired. Therefore, in view of the inefficiencies and high maintenance costs of the ordinary flat belted drive on short centers, it has been necessary to develop a number

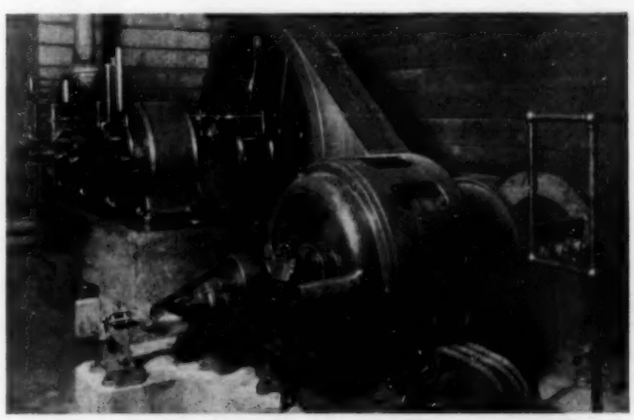


Fig. 11—Short-Center Driving Illustrated by 75-Hp. Motor Belt-Connected to Compressor, Using Automatic Idler

of efficient short-center driving methods which the chemical engineer now has at his disposal.

On flat-belt short-center installations such as compressors, pumps, blowers and exhausters the automatic idler drive practically eliminates the difficulties of the ordinary method of short-center open-belt driving. Fig. 11 illustrates a 75-hp. motor driving a compressor on 8-ft. centers with a ratio of 8 to 1, using the automatic idler. Such an installation would be impossible with the open flat-belt drive.

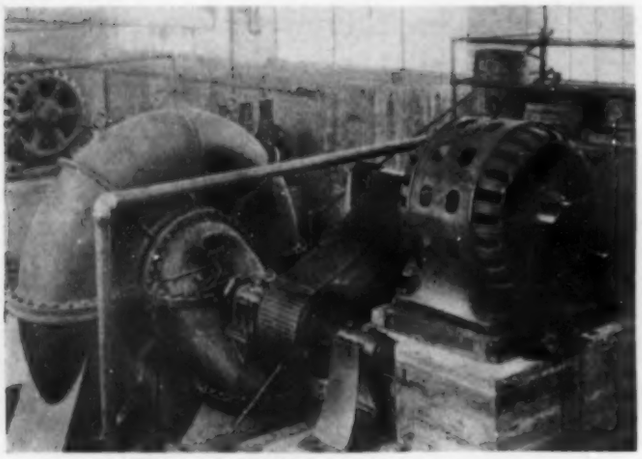


Fig. 13—Silent-Chain Drive Connecting 50-Hp. Motor to High-Pressure Centrifugal Pump

Fig. 14—Tandem Silent-Chain Drive Used to Operate Ball Mill With 500-Hp. Motor

The chief function of this device is to increase the arc of contact of the belt on the driving pulley. In addition to this, the idler pulley is applied to the belt scientifically or in such a manner as to equalize the belt tension in accordance with the load transmitted.

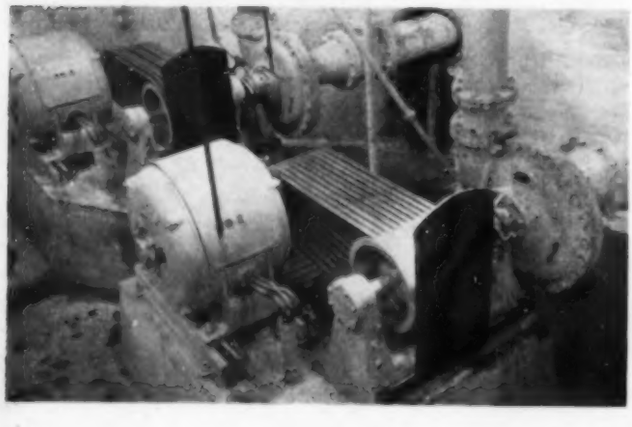
This type of drive introduces mechanical accessories for controlling automatically the idler pulley, which to some engineers are objectionable. In such instances resort may be made to the multiple-V-shaped rubber and fabric rope system as shown by Fig. 12. This illustrates the driving of high-speed centrifugal pumps by 20-hp. motors on 3-ft. 6-in. centers. This system is highly efficient, requires no lubrication, is silent, and necessitates no accessories. It is applicable to various types of chemical-apparatus driving where adjustment between driver and driven equipment is possible.

On drives of the characters just discussed a small percentage of actual slippage always is present, due chiefly to the element of creep, which cannot be eliminated in driving with flexible bands, regardless of their cross-section. Therefore, on the low ratios of short-center driving, where positive, accurate speeds must be delivered from prime mover to apparatus, the silent or finished steel-roller chains are employed. The silent chain which is most generally used for such service is 98½ per cent efficient and operates without slip or creep. Fig. 13 shows this type of chain driving from a 50-hp. motor to a high-pressure pump on 4-ft. centers. Fig. 14 illustrates its use in tandem from a 500-hp. motor to a grinding mill on 8-ft. 8-in. centers.

Drives of this character usually are inclosed with a steel oil-retaining casing so that the many links and pins of the chain may be continuously and thoroughly lubricated. The silent-chain drive is applicable to all manner of chemical and industrial driving and when properly installed and maintained will operate for many years.

The perfection of mechanical driving has been achieved by the tireless efforts of mechanical engineers. The results of these efforts have to a marked degree made possible modern chemical engineering equipment, because practically all such equipment must be driven. The driving of chemical-plant apparatus would be uneconomical and inefficient by the old methods of mechanical power transmission.

Fig. 12—20-Hp. Motors Driving Centrifugal Pumps on 3-Ft. 6-In. Centers With Multiple-V-Belt Drives



Large Solarium Uses Fused Quartz Windows

WHAT is believed to be the largest solarium in the world to use fused quartz windows has just been completed at Saranac Lake, N. Y., as part of a new sanatorium. Fused quartz permits the passage of about three-quarters of the ultra violet radiation in the sunlight, more than any other material that can be used for windows, and has as a consequence been recently used occasionally for the purpose. It is probable that increased use will follow the introduction of a new process by which the quartz used in this case was produced by the General Electric Company.

With the melting point of quartz near to 3,200 deg. F., some three times that of the average glass, and the fused product very viscous, the production of clear quartz panes at a reasonable cost has presented unusual difficulties. It is reported that the new General Electric process has cut the cost to about a fifth of what it formerly was.

According to the new process quartz crystal is crushed to ¼-in. mesh and fused in a vacuum furnace on flat graphite disks placed between graphite slabs which are in the form of a square, 7½ x 7½ in. When the quartz is fused, nitrogen is admitted to the furnace at a pressure of 150 lb. per square inch to compress the bubbles and give a clear product. The resulting panes are ground on the edges to 7½ in. square and require no further treatment. The thickness is ¼ in. The new method does away with the cutting of panes from a cube required in the old process as well as grinding and polishing of the faces.

Welding Society Discusses Non-Destructive Tests

WITH THE PRESENTATION of two papers on non-destructive tests before the American Welding Society at its Cleveland meeting, September 10 to 13, it is believed that a way has been paved to the removal of the most serious of the objections that have been advanced against the use of welding for equipment and structural fabrication.

Welding, in distinction to other methods of fabrication, has always presented the difficulty that the reliability of the weld depends entirely upon the skill of the welder. Riveting, with all its inherent limitations, has often been the preferred form of construction for many purposes for the reason that inspection of the joints can be expected to give a reasonable idea of the quality of the work. In the case of welding, however, both hammer and fusion, actual destruction of the weld has been the only certain method of determining its suitability. Welded equipment intended for pressure service has regularly been given hydrostatic tests at pressures in excess of those to be used in actual operation, and in addition the joints have ordinarily been hammered while the vessel was under pressure, but even these seemingly stringent tests have frequently been a subject for skepticism on the part of more conservative engineers. Although the best practice of the past has undoubtedly resulted in welds which were absolutely safe, the new non-destructive tests should go far in removing the last doubts of the conscientious objectors.

Three tests are suggested. One of the two tests covered in the paper by A. B. Kinzel, C. O. Burgess, and A. R. Lytle, X-ray examination, is of course not new, except in its method of application and in the manner in which the other test suggested by these authors is used to indicate location for X-ray photographs. The test suggested in the second paper by Elmer A. Sperry, president of the Sperry Development Company, is also not entirely new, in that it is an extension of a system previously developed by Mr. Sperry for detecting flaws in railroad tracks. However, the application of this system to the inspection of welds is a very recent achievement.

THE ORIGINAL Sperry machine for testing rails is based on the theory that electrical resistance of the rail is affected by the presence of flaws. The machine consists of an electrical detection device coupled to a series of vacuum tubes to amplify the indications. The amplified current is caused to operate an indicator needle and also to apply a small amount of paint on the rail at the defective point. The detecting device consists of a pair of brushes in contact with the rail, through which an electric current is passed. Three auxiliary brushes located between the two points of current supply are connected to the ends and the midpoint of one of the windings of a transformer. Any sudden change in resistance between one of the two pairs of brushes, as when the test car passes over a defective point in the rail, causes an unbalanced condition of the current in the two halves of the transformer winding, and results in a "kick" which can be amplified and transmitted to the record.

It is obvious that the same system can be applied to the detection of defects in welds. Any sort of flaw will tend to increase the local resistance to the flow of electric current and will hence deflect the needle.

A machine has been constructed for testing welded joints in plates up to 4 inches in thickness, as well as for testing cylindrical shapes. The test is rapidly carried out, and gives an ink record of the weld.

In the testing system advocated by Messrs. Kinzel, Burgess, and Lytle, of the Carbide and Carbon Research Laboratories, a very simple test is used to indicate the location of defects. This may be used alone, but if more complete information as to the nature of the defect is desired, it is necessary to use the X-ray machine. The simple test consists essentially in the use of a stethoscope to detect variation in the vibrations of a tank or other welded object when it is struck at different points along the weld.

The method depends upon the fact that flaws in the weld will result in a different character of vibration within the metal when struck a hammer blow at the point of the flaw.

A SIMPLE VARIATION of this test has long been known. Blacksmiths are accustomed to detect unsoundness of metal by striking it cold upon an anvil. In the case of tanks, however, the complexity of vibrations is such that a special means must be used to detect the vibrations characteristic of a defect. The authors of this paper use a stethoscope to overcome these difficulties. It consists of the type ordinarily employed by physicians with the addition of a gum rubber tip which serves to exclude extraneous sounds and gives better contact on irregular surfaces. The stethoscope is applied to any part of the structure near the point to be tested, after which the hammer is struck directly upon the surface of the weld or within an inch either side. The force of the blow may be varied to give the best results, dependent upon thickness of the plate and the personal equation of the operator.

It is the opinion of the authors that anyone with normal hearing and a little experience can readily detect the difference between poor and satisfactory welds. After the characteristic sound inherent in each type of welded structure has been determined, it is only necessary to move the hammer and stethoscope along the weld, so that any irregularities may be spotted. In fact, it is not even necessary to move the stethoscope frequently, as satisfactory results can still be obtained when the stethoscope and hammer are some distance apart.

The authors have found that they are able to check one another quite satisfactorily with this method. In checks on specimens in which defects had purposely been introduced at unknown points, no difficulty was experienced in determining the true location of the defect by means of the stethoscope.

In the past, most X-ray work on welds has consisted in taking photographs directly through the weld. When the rays pass in a direction normal to the plane of the plate defects, such as lack of fusion along the scarf in V-welds, are not clearly registered on the film. However, if three photographs be taken, one parallel to each scarf and one normal to the plate, a comparison of the three will eliminate this difficulty. Lack of fusion can then be detected by means of a characteristic spot on the film. Knowing the plate metal and the welding rods used, the authors have been able to use the X-ray photographs in judging with considerable accuracy the ultimate strength of welds.

"Creep Limit" Alters Technique in Design of Large Tanks

By Joseph Kaye Wood
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"Creep Limit," the degree to which a metal can be stressed for a prolonged period without permanent set, at a definite high temperature, has lately gained prominence as a design criterion. Mr. Wood here discusses design from the new standpoint. A second article, to be published in a subsequent issue, will present ready means, including a comprehensive nomographic chart, for applying the new technique in actual tank design.

PRESSURES and temperatures in the oil industry, as in the power-generation field, have increased to such an extent under present-day conditions that the design of large oil containers must be based upon exact engineering principles. In the cracking of oil, containers 40 ft. long and 10 ft. in diameter must withstand pressures as high as 600 lb. and temperatures as high as 950 deg. F., which, considering the more or less corrosive action of the various oils, requires absolute certainty on the part of the designer in proportioning these containers. In the case of tank failure, the designer may be indirectly charged with the resultant loss of life and property. Codes of design sanctioned by governmental bodies and applied by their inspectors are entirely out of line with the new principles upon which the design of such tanks should be based. A comparison of these design methods with the more correct modern one, will illustrate this fact clearly.

In a cylindrical tank in which the ratio of the internal to external diameter is practically equal to unity—say in the order of 0.90 to 0.99—a uniform internal pressure due to the confinement of a gas or liquid will produce a uniform tension circumferentially in the cylindrical wall. Also there will be produced a uniform tension longitudinally in the cylindrical wall but of only half the value of the circumferential tension.

The heads of the tank, on the other hand, must withstand a more or less complicated stress, the rate of transition—from the circumferential stress in the cylindrical wall to pure shear toward the center of the head—differing with the various types of heads. The transition in the case of the spherical type of head is practically uniform and nearly so in the elliptical type of head. The former type is seldom used while the latter is beginning to make its appearance in this country.

The type in most common use is designed by joining the very large radius of the main or spherical portion of the head to the cylindrical portion of the tank by means of a relatively short radius. The transition from cylindrical tension to pure shear is quite abrupt at the junction of these two radii, thus causing a high stress concentration at this point and subsequent easy failure of tanks using this type of head. Although the shear stress in the relatively flat portion of the head is much less than either the longitudinal or circumferential stress in the cylinders, the concentrated stress in the region of sharp transition may in severe cases be even greater than the circumferential stress. Properly designed tanks for use in high-pressure and high-temperature service should therefore have elliptical heads, in which case the thickness of the material in the heads and cylinder may be made the same. The criterion for determining the actual stress in the design of tanks is the formula that gives the value of the circumferential stress in the cylinder. Naturally, this criterion has nothing to do with the nature and quality of the material composing the tank walls.

In the foregoing discussion, it was assumed that, with the exception of the heads, the tank consisted of a single sheet of material, whereas in actual practice, large tanks must of necessity be made by joining many sheets together. Hence the effect of such joints on the continuity and uniformity of both the circumferential and longitudinal stresses in the cylindrical wall must be taken into consideration when calculating the dimensions of a tank. Of the various types of plate joints none completely destroys the continuity of stress throughout the full length and width of the tank, but within a small region on either side of the joint the stress will be concentrated to an extent depending upon the type of joint employed.

The various types of joints used in constructing tanks are as follow:

1. Riveting.
2. Hammer or forge welding.
3. Fusion welding.

Riveting, of course, is highly inadequate for tanks used at 950 deg. F. since the rivets in expanding longitudinally will cause the plates to loosen sufficiently to allow the hot corrosive oil to leak and corrode the joint. Fusion welding is a relatively new art that is proving to be quite reliable in service. Hammer or forge welding, on the other hand, is a very old art and has been developed to a high state of perfection.

The essential factors for reliable hammer welding are:

(*a*) Uniformity in quality of material.
(*b*) Method of manufacture.
(*c*) Heat treatment of welded tank.

The careful preparation of steel plate for hammer welding is of the utmost importance. Frequent in-

spection service must be established in the production of these plates in order to insure uniform chemical and physical qualities. Constant and skillful attention also must be given to the welding process so as to make certain that all of the lap-welded joints are 100 per cent reliable. To attain this end, all steel plates should be cropped and annealed before bending. Furthermore, the completed tank should be annealed in a furnace sufficiently large to inclose it completely, special provision being made for properly supporting the walls of the tank. Welded and unwelded test specimens should be made simultaneously with the construction of the tanks, under identical conditions, for the purpose of determining the efficiency of the weld under short- and long-time (creep) loading. Tests at 932 deg. F. have shown that a good weld will be stronger than the unwelded material itself; that is, it apparently will be more than 100 per cent efficient. However, since the weakest point in the welded joints of a tank is the governing criterion in design, it is considered good practice to base all calculations of plate thicknesses on the more conservative figure of 90 per cent efficiency for all types of welded joints.

Stress Calculations

IT WAS previously stated that the criterion for determining the actual stress in tank design is that formula which gives the value of the circumferential stress in the cylindrical portion. The formulas giving this stress are as follow:

$$S_a = \frac{P\,D}{2\,t} \qquad (1)$$

in which S_a is the actual circumferential stress in pounds per square inch due to internal pressure, P, also in pounds per square inch. D is the internal diameter of the tank and t the thickness of the tank, both in inches.

Now the actual stress S_a must be less than the safe working stress S_w to insure safety against failure; and equal to S_w to secure the additional factors of economy and standardized practice. In the oil-cracking and similar industries, code practice has been to determine S_w from the following formula:

$$S_w = \frac{e}{100f}\ T.S. \qquad (2)$$

in which $T.S.$ is the ultimate tensile strength in pounds per square inch at room temperature, e the welding efficiency, usually taken at 90 per cent, and f the factor of safety, usually taken at 5.

Recent independent practice has been to determine S_w in the following manner:

$$S_w = \frac{e}{100f}\ M \qquad (3)$$

in which M is either the yield point or the proportional limit in pounds per square inch at service or elevated temperature, e the welding efficiency taken at 90 per cent and f the factor of safety taken at 2.5.

Instead of formula 2 or 3 the writer proposes the following:

$$S_w = \frac{e}{100f}\ C.L. \qquad (4)$$

in which $C.L.$ is the creep limit (a property to be fully discussed below) in pounds per square inch at service temperature, e the welding efficiency taken at the same value of 90 per cent, and f the factor of safety taken at only 1.5. For comparison, the equivalent factor of safety, $\frac{e}{100f}$, as employed in each of the four methods, is evaluated in Table I.

Table I—Equivalent Factors of Safety With Different Design Criteria

	Tensile Strength, Room Temp.	Yield Point, Service Temp.	Proportional Limit, Service Temp.	Creep Limit, Service Temp.
Weld efficiency, $e/100$....	0.9	0.9	0.9	0.9
Factor of safety, f.....	5.0	2.5	2.5	1.5
Equivalent factor of safety, $\frac{e}{100f}$	0.18	0.36	0.36	0.60

Referring to Table II, in which the safe working stress S_w is determined for two typical steels by each of the four methods mentioned above, it will be noted that the values obtained for a given material are not equal, which is not what would be expected. In explanation it may be advanced that the basic physical properties from which the values of S_w are calculated may lie more or less close to the true safe stress. If the basic physical property turns out to be equal to or less than S_w, then the equivalent factor of safety is equal to or greater than unity, which in the latter case simply means that the laboratory test conditions erred on the safe side, and resulting designs, although uneconomical, are safe. Herein lies the explanation of the inconsistency of S_w values shown in Table II.

In choosing a physical property as the stress value upon which to base the maximum safe stress, the following points should be taken into consideration:

(*a*) A basic physical property is required only when the maximum safe stress, S_w, is not known due to the lack of precedent.

(*b*) Laboratory test conditions under which the physical property is determined should approximate actual service conditions as closely as can be. A possible exception to this rule is where stresses under actual conditions bear a definite relationship to stresses under laboratory test conditions.

(*c*) The degree to which the laboratory test conditions approach actual service conditions determines the value of the factor of safety.

(*d*) A certain part of the factor of safety should cover probable fluctuations in service conditions due to abnormal circumstances.

(*e*) A physical property that is decidedly of much lower value than the maximum safe stress should not be used as the basic property.

Considering the four methods of determining S_w, it will be noted that the first method, in which the tensile strength at room temperature is the basic physical property, is in direct contradiction to rule *b*. In general, the tensile strength at temperatures above 500 deg. F. bears no definite relationship to the tensile strength at room temperature (68 deg. F.). The factor of safety, 5, which usually is associated with this method, is based upon long precedent in which the maximum temperature was about 500 deg. F. and not 932 deg. Perhaps if a factor of safety equal to, say, 10 were to be used in this method for the higher temperature, resulting tank designs would be safe enough, but then they probably also would be uneconomical.

Table II—Typical Examples of Maximum Safe Working Stresses Based Upon Different Physical Properties

The roman figure listed under each design criterion is the measured physical property, while the italic figure represents the maximum safe working stress, S_w calculated from that property.

	Design Criteria, Lb. per Sq. In.			
	Tensile Strength, 68 Deg. F.	Yield Point, 932 Deg. F.	Proportional Limit, 932 Deg. F.	Creep Limit, 932 Deg. F.
Firebox Steel.....	50,000	16,800	8,000	7,000
S_w.....	*9,000*	*6,050*	*2,900*	*4,000*
Vanadium steel.....	64,000	27,000	6,000	14,000
S_w.....	*11,500*	*9,700*	*2,150*	*8,400*

The yield point method is much better than the tensile strength method, since it is more in accordance with rule *b* and also because of another advantage based upon the fundamental difference between the tensile strength and yield point of a material. The former property is that stress at which the material will rupture, based upon the original cross-sectional area, while the latter is that stress at which the material begins to yield to permanent deformation quite definitely and at which the cross-sectional area begins to decrease. Now the service required of an oil tank, stated broadly, is to hold oil under the imposed conditions. So long as the tank remains unruptured, it will perform the required service, no matter whether is becomes enlarged, due to deformation beyond the yield point of the material, or not. This reasoning would be practical were it not for the fact that the yield point is the warning signal against rupture, because once the point has been exceeded, metals flow more easily and rapidly to the breaking point. This is particularly true of metals at elevated temperatures, because they become more plastic and mobile.

THE THIRD or proportion limit method is much safer than even the yield point and probably in some cases errs to much on the side of safety, thus becoming a source of uneconomical design. Aside from these considerations it has the disadvantage of being highly inaccurate and impracticable, due to the great difficulty of measuring the proportional limit at elevated temperatures even under the most ideal laboratory conditions. To date little or no research of importance has been done on the proportional limit at elevated temperature. There is sufficient isolated data, however, to show that the ratio between the proportional limit and the yield point of a given material, particularly a steel, is usually close to unity at room temperature and decreases gradually with increase in temperature until a temperature of 500 deg. F. is reached, after which it decreases very rapidly. Recent tests on a low-carbon steel of firebox quality indicate that creep effects become evident for stresses just exceeding the proportional limit determined at the elevated service temperature.

On the other hand, similar tests on a special vanadium steel indicate that creep effects may not become evident for stresses considerably above the proportional limit. This difference in behavior between low-carbon and vanadium steel may be explained on the basis of crystallographic arrangement; i.e., that there may be more crystals of the plastic or "easy-flow" type in one metal (low-carbon steel) than in the other. Hence the assumption as a general criterion that the proportional limit is the basic physical property to use to avoid creep effects would not be justified or advisable. Since the term "creep" is a relatively new one, it might be well to state at this point that it is a permanent deformation which takes place very slowly under a sustained stress. At room temperature, creep in steel is inappreciable, but at elevated temperatures, particularly as high as 932 deg. F., creep effects are quite noticeable and must be given serious consideration.

Why the "Creep Limit?"

MOST METALS in use consist of an aggregate of different kinds of crystals oriented haphazardly. One group of these crystals may be soft with low proportional limits while another group may be hard with high proportional limits. The proportional limit of the metal as a whole is a statistical average of these two groups with their infinite directions of crystal orientations. This explains the very gradual deviation of the stress-strain curve at the proportional limit. That is, the crystals reach their individual proportional limits progressively until, at the yield point, practically all of the crystals have reached their individual proportional limits and the metal yields more rapidly at first, then slows up again due to strain hardening of the crystals. This explanation is in accordance with a theory advanced several years ago by the writer, in which it was reasoned that the pronounced yield-point dip in the stress-strain diagram of soft steels is an inertial effect, due to the fact that the crystals, being nearly all equal in hardness, slip all at once; and recover, due to strain hardening, all at once also.

The proportional limit, as determined in the laboratory, probably is far from being the true proportional limit. This is particularly the case in metals of mixed crystals, because the initial deviation is too small to be within the sensitivity of the testing equipment. It would be incorrect, however, to say that the deviation is of an asymptotic nature because the number of crystals in a test specimen is finite. In other words, there is a true proportional limit but it is smaller than the measured proportional limit. The writer has been of the opinion for some time that the true proportional limit is approximately equal to the fatigue endurance limit (reversed stress) because both correspond (or nearly so in the case of the latter) to that stress at which the first crystal slips or yields.

UNDER sustained stress at room temperature, steel will not *continue* to take a permanent set (creep) during long periods of time unless the stress is almost equal to the yield point. At elevated temperatures, particularly as high as 932 deg. F., creep will take place for stresses far below the yield point, but not below the proportional limit. Since, as stated previously, the ratio of the proportional limit to the yield point at highly elevated temperatures is rather low, the "creep limit" (which is defined by the writer as that maximum stress which, if sustained 1,000 hours at a given temperature, will cause no appreciable creep) will fall between two widely separate limits, its exact position depending upon the nature of the material. For the low-carbon steel previously mentioned (Table II), the creep limit is slightly above the proportional limit, probably for the reason that this type of steel is quite uniform in the physical properties of its individual crystals. This is borne out by the fact that for the special vanadium steel also mentioned previously (Table II), which is not as uniform so far as the physical properties of the individual crystals are concerned, the ratio between the proportional limit and yield point at 932 deg. F. is 0.22, while for the low-carbon steel it is 0.48.

It is obvious therefore that, in so far as creep is concerned, the proportional limit at the elevated or service temperature does not have any general significance, with the exception that below the true proportional limit no creep, of course, can occur. The difference in value between the true proportional limit and the laboratory test proportional limit is variable, depending upon the sensitivity and accuracy of the particular test equipment used and the temperature. At elevated temperatures as high as 932 deg. this divergence probably is very wide. Consequently the use of the proportional limit as the basic physical property for the design

of large oil tanks is more or less inaccurate, and for some metals, such as the vanadium steel quoted, is likely to lead to highly uneconomical design. The use of this limit, however, would never lead to unsafe design except in the case of absurdly great inaccuracy in determining the limit at the service temperature.

On the basis of the principle that creep at sustained stress will ultimately lead to yield point proportions, which, as stated previously, is the "danger signal" against rupture in short time, it is here proposed by the writer that the creep limit be made the criterion for the design of oil tanks. Since we know that the creep limit always is smaller in value than the yield point, we may cut down the factor of safety, f, to 1.5, which suggestion conforms to formula 4.

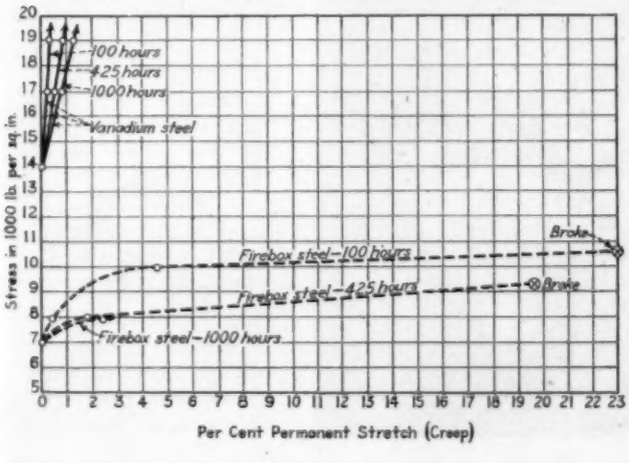
In steels, creep effect is not appreciable below the yield point until a certain temperature is attained, probably in the order of 500 deg. F. In the laboratory determination of the creep limit, constant loads in the form of suspended weights are simply applied to a specimen of metal for a duration of 1,000 hours. Depending upon the service conditions anticipated, the specimen is brought up to a certain temperature by surrounding it with a suitable furnace. Movements of the load, if any, are observed or automatically recorded at regular intervals throughout the 1,000-hour period and the stress in pounds per squarte inch at which no appreciable creep is observed throughout the full period of 1,000 hours is termed the creep limit. This type of test is so simple and rugged that the results obtained by it are very consistent and accurate. The graph shows the results of creep tests made on the low-carbon or firebox steel and the vanadium steel listed above in Table II. A study of these curves indicates that the proportional limit bears no relation to the creep limit, at least not so far as vanadium steel is concerned.

Future Investigations

KNOWLEDGE of the creep effects of many engineering metals is imperative for present-day use. But since we have neglected in the past to foresee today's requirements, and since time is needed to conduct adequate investigations, it becomes a very serious industrial duty, particularly as regards safety and economy, to provide without further delay the necessary facilities for conducting a comprehensive investigation into the creep effects of the engineering metals at elevated temperatures.

In the cracking of oils, corrosion is quite considerable, depending more or less upon the source of the crude oil. Consequently, any research investigation planned should include the corrosive influence of the oil at the cracking temperature. It is suggested that this be accomplished by heating the creep-limit test specimen in a bath of the same oil that is refined in service. It is further suggested that a series of small tanks—say, 4 ft. long and 1 ft. in diameter—be filled with oil under representative pressures and temperatures and the expansion of the diameter, if any, observed over a period of one or two years. The thicknesses of these tanks would be varied so as to develop stresses ranging slightly above and below the 1,000-hour creep limit.

Comparison of Creep of Vanadium and Firebox Steels for Varying Loads and Times of Exposure at 932 Deg. F.



IN A PROGRAM such as this the conditions encountered in service must be taken into consideration. Three principal forces act simultaneously in the oil-cracking process to tear down the metal of the container or still. These forces are: (*a*) Sustained stress due to sustained pressure of 200 to 600 lb. per square inch; (*b*) elevated temperature, usually 900 deg. F. or more; and (*c*) corrosion by acids in oils. Stated collectively, a metal to withstand the combined effect of these forces satisfactorily must have sufficient fatigue corrosion resistance, at the service temperature and at a given sustained stress, to prevent permanent distortion or fracture throughout a required period of time.

Fatigue corrosion of a metal has been recognized only recently as a property worthy of investigation. D. J. McAdam, of the U. S. Naval Experiment Station at Annapolis, is practically bearing the full burden of this investigation. His general procedure in this work is to put a test specimen through a large number of cycles of reversed stresses while it is under a stream of either saline solution or river water. In this manner Dr. McAdam determines what he calls the fatigue endurance limit of the metal, provided any limit exists for the particular metal being tested. However, little or no work has been done in the investigation of fatigue corrosion properties of metals in which a sustained stress is employed either at room or elevated temperature. In fact failure by creep is a very different process from failure by fatigue, such as we have come to understand it, through the repeated-stress test. Failure resulting from repeated stress is due to attrition between two slip planes of a crystal, while failure resulting from creep probably is more similar to the characteristic ductile break of a tensile test specimen under a short-time static load.

A sustained stress or stress applied to a metal constantly throughout a given period, therefore will have a very different effect than would the stress if applied momentarily for a certain number of times within that same period. Increasing the sustained stress has the effect of bringing into action more of the plastic phase in the metal, and increasing the temperature has the effect of increasing the mobility of the plastic phase and decreasing the elasticity of the metal.

Until an investigation of creep effects at elevated temperatures as broad and comprehensive as the several fatigue investigations now in progress is made on all types of steels and alloys, no general conclusions can be drawn as to creep limits and their possible relationship to any of the short-time physical properties. As in the fatigue investigations, the simultaneous effect of corrosion due to various reagents, such as 1 per cent sulphuric acid, on the creep limit at elevated temperatures should be determined.

Ammonia Oxidation Makes Further Gains in Chamber Plants

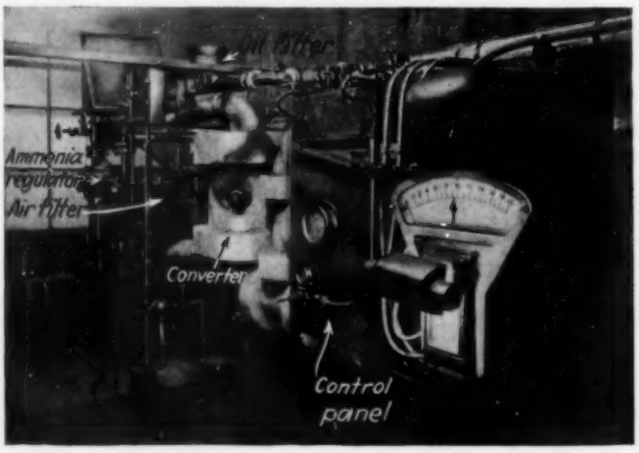
By Theodore R. Olive
Assistant Editor, Chem. & Met.

OXIDATION of ammonia has, within the past three years, made rapid progress as a means for production both of nitric acid and of oxides of nitrogen. In fact, the important producers of nitric acid have turned so completely from Chile nitrate to the use of ammonia that nitre cake, once something of a drug on the market, now commands prices that indicate a decided shortage. While the change of front that ammonia oxidation has produced among sulphuric acid producers is less spectacular, it is no less indicative of a very marked change in practice.

In the past, the nitration process of sulphuric acid manufacture has always consumed a small but important proportion of the total Chile nitrate imports of the United States. Based upon 1928 figures and assuming that all chamber acid had been made by potting nitrate, approximately 3½ per cent of the nitrate imports would have been thus accounted for. At the present time 50 of the largest chamber acid plants in the country are producing their acid by means of oxides of nitrogen, obtained by oxidation of ammonia, and it is estimated that these 50 plants produce about 80 per cent of all the chamber acid manufactured in the United States. The reason for this widespread use of the ammonia oxidation process, lies in the development of small easily operated ammonia oxidation units, which produce nitrogen oxides at considerable savings over potting nitrate of soda. Reductions in the cost of producing chamber acid of from 20 to 40 cents per ton of 60 deg. Bé. acid, depending on the capacity of the plant, are being reported by manufacturers who have installed ammonia oxidation units.

An earlier article (S. F. Spangler, *Chem. & Met.*, **35**, 1928, 342-4) went into the economics and technology of ammonia oxidation for chamber plants. The present article has as its purpose the discussion of the oxidation system developed by the DuPont company, and which is being sponsored by the DuPont Ammonia Corporation. It should perhaps first be pointed out that this oxidation unit is made for the specific purpose of supplying nitrogen oxides to sulphuric acid chambers and, while similar in certain respects to the new DuPont oxidation system used in the production of nitric acid, differs from it inasmuch as the unit described here operates under a pressure in the converter only a few ounces above atmospheric while the nitric acid system employs a substantial working pressure. The acid plant, has in addition, a comprehensive absorption system which is not required when the oxides are to be used immediately, as in a chamber plant.

Fig. 1—General View of One of Smaller Ammonia Oxidation Units in Davison Chemical Company's Sulphuric Acid Plant



The oxidation of ammonia has long been known to take place slowly at elevated temperatures, in the presence of air or oxygen, without catalytic assistance. However, to be commercially valuable, the reaction must be speeded up catalytically. It has been recognized for some time that platinum is a very efficient catalyst for this reaction. As a consequence, platinum catalysts were employed in the first oxidizing units and are still used, with the difference, however, that the early units required heat from an external source, ordinarily electric current, to maintain the catalyst at the bright cherry-red heat required for efficient conversion. With the recent extensive development of oxidation processes, the same expedient used in ammonia synthesis and contact sulphuric acid manufacture has been applied to eliminate this external heating. The heat of reaction is given up in part to the incoming gases so that the gauze is maintained at the higher temperatures necessary for the best conversion efficiencies.

An outstanding development has recently been made in catalysts for ammonia oxidation purposes. It has been found that by substituting a portion of the platinum by rhodium, a catalyst which gives a higher conversion efficiency and a longer life is obtained. This new platinum-rhodium alloy for ammonia oxidation designated as No. 750 alloy, has been developed jointly by the DuPont company, and Baker & Company, and is now being widely used both in this country and abroad.

The DuPont oxidation units described here are the six which are being used on the six chamber sets in the Curtis Bay plant of Davison Chemical Company, at Baltimore. This company, one of the largest producers of superphosphate in the country, has a daily capacity of about 700 tons of sulphuric acid, expressed as

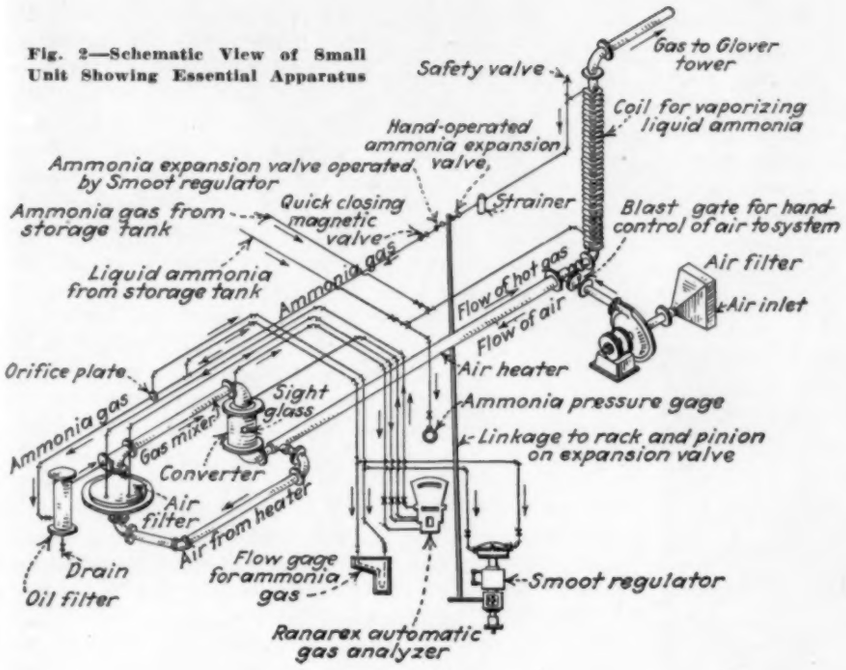


Fig. 2—Schematic View of Small Unit Showing Essential Apparatus

A hasty glance at the interrelation of the three lines of flow will make the heat-transfer system which is used readily understandable. Hot reaction gases leaving the converter pass through a double-pipe heat exchanger, counter to the filtered air forced into the system by a small blower. The hot gases from the converter then pass up through a vaporizer or gasifier, vaporizing the incoming anhydrous ammonia, and on to the Glover tower. The ammonia gas joins the hot air stream in a mixing chamber and passes into the converter. This, in brief, comprises the essential operation of the system.

Reference to the isometric view will show this relation even more clearly. A small volume blower draws air through a Mid-West air filter of the type in which dust particles impinge and are collected on oiled surfaces. Air then passes through a blast gate for regulating the flow of air and on through a double-walled heat exchanger consisting of three sections arranged in parallel. From the heat exchanger, flow is through an asbestos filter. The latter consists of an enlarged chamber containing a layer of loose asbestos supported between screens and perforated metal plates. All air piping from the blower to the under side of the asbestos filter is of 4-in. diameter and is of steel. Aluminum is the metal used for the converter side of the filter, as well as for all piping from the filter through the mixer to the converter.

Careful filtration of the air is necessary to insure long life of the platinum catalyst. A minimum of attention to the filters is needed. This includes the change of the Mid-West filter cells, an operation taking only a few minutes, about once a week, and renewal of the asbestos in the hot air filter only at six-month intervals.

50 deg. Bé. This is divided between the six chamber sets and three contact units, the latter employing the new Silica Gel contact catalyst. Two additional contact units are now under construction. The first of the ammonia oxidation units went on the line about a year ago. Prior to that time, nitrogen oxides had been supplied both by potting nitre and by spraying sodium nitrate solution. The new units have now stabilized the chamber operation, which in itself effects a considerable saving, and in addition return a saving amounting to about the difference between the cost of nitrogen in anhydrous ammonia and in the form of sodium nitrate.

Two styles of unit are in use, a smaller having a nominal capacity of 24 lb. of ammonia per hour and a larger, of 36 lb. per hour. At rated capacity the first is equivalent to about 120 lb. of $NaNO_3$ per hour and the second to 180 lb. Each is capable of sustaining a 50 per cent overload indefinitely without appreciable reduction in conversion efficiency, and can be operated at 100 per cent overload with only a slight loss in efficiency. Four of the smaller and two of the larger units have been installed. Aside from the superficial differences in appearance, the principal variation that distinguishes the two types is one of size. It will consequently suffice to describe one of the smaller units.

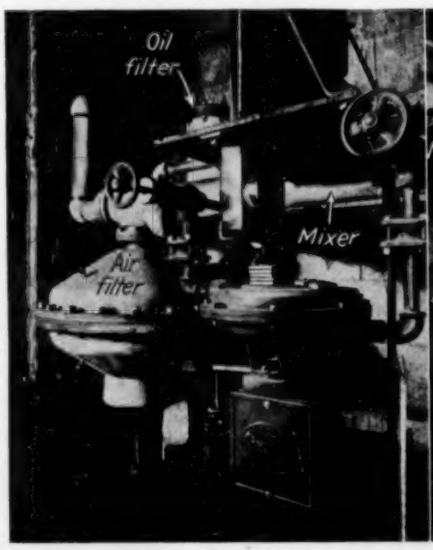


Fig. 3—View of One End of Oxidizer Room Showing Oil Filter, Air Filter, Mixing Pipe and Automatic Ammonia Controller

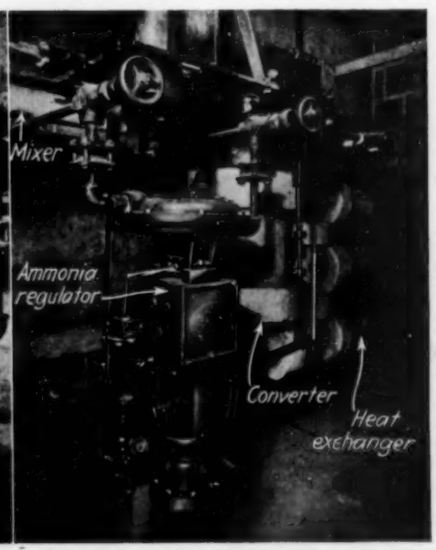


Fig. 4—Another Section of the Equipment Showing Ammonia Regulator, Converter and One End of Heat Exchanger

Oxidation of ammonia requires the flow of materials in three separate lines. Ammonia gas in the first line and air in the second converge at the mixer, pass through the converter and leave the system in the third line as NO, air and excess nitrogen. No unconverted ammonia passes the platinum gauze. Formation of the higher oxides proceeds after conversion, although it is considered that the immediate product of the combustion at the catalyst is NO.

A manometer connected across the asbestos filter indicates when repacking is necessary.

Ammonia storage for all units is provided in a single hammer-welded steel tank of 14,000 gallons capacity. Anhydrous ammonia, 99.5 per cent or more NH_3 content, is unloaded by means of a small standard ammonia compressor. There are two pipe lines connecting the storage tank with the tank car. One of these lines is connected with a stand pipe reaching to the bottom of the tank car, the other being connected to the gas space in car. The ammonia compressor draws gas from the

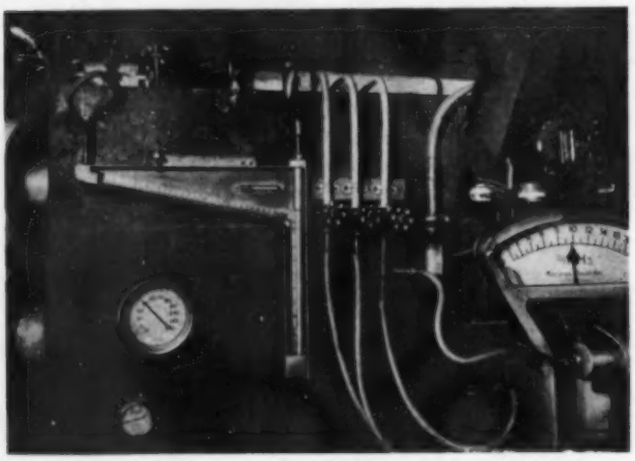


Fig. 5—Control Board With Pressure Gage, Flow Gage and Gas Composition Indicator

top of liquid in the storage tank, discharging the compressed gas on top of the liquid in the tank car, thus decreasing the pressure in the storage tank and increasing the pressure in the tank car. The liquid anhydrous ammonia moves into the storage tank through the second pipe line. When all the liquid ammonia has been discharged from the car, connections at the compressor are reversed by suitable valve arrangement and the remaining gas in the tank is withdrawn and discharged into the storage tank.

IT IS NECESSARY to vaporize the liquid before use. This is accomplished in a vaporizer column consisting of a coil of about 200 ft. of 1-in. extra-heavy steel pipe surrounding a straight pipe through which the oxides are conveyed into the chambers. Space between the coils is packed with iron filings to facilitate heat transfer.

Ammonia from the storage tank, both liquid and gas, is piped to the bottom of the vaporizing coil. The gas line is used only when starting a cold unit. After the unit becomes hot, the ammonia gas from the storage tank is shut off and liquid ammonia is allowed to enter the vaporizing coil. The vaporized ammonia passes off from the top of the coil to a strainer and through an expansion valve regulated by a Smoot volume controller. This can be adjusted to deliver a constant flow of ammonia of any quantity within the capacity of the unit. The flow of gas is then through a magnetically controlled valve connected with the blower circuit. Should power fail, flow of ammonia is immediately cut off. Next in the ammonia line is an orifice with leads connected both to a manometer, which is graduated in terms of ammonia flow, and to the volume controller.

Ammonia is then filtered through a cylinder packed with steel wool and asbestos to remove oil and is passed through an aluminum pipe, terminating in a spray nozzle, to join the hot air stream at right angles to the latter and at the entrance to the mixer. This, in the smaller unit, consists simply of a 4½-ft. length of aluminum pipe of 3-in. diameter, and in the larger unit is a baffled chamber. A small sample of the ammonia-air mixture is continuously withdrawn from the exit end of the mixer and passed through a Ranarex ammonia analyzer which continuously shows the percentage of ammonia in the gas. This device, originally developed in the gas industry, has now been taken over into ammonia oxidation where its principle of comparing the density of the sample with a standard gas has proved very effective. In this case, the standard gas is air withdrawn from the asbestos filter. The sample, after passing through the Ranarex, is returned to the gas stream entering the converter, so there is no loss of ammonia.

THE CONVERTER is of the Parsons type and is a cylindrical steel chamber lined with plastic refractory. Gases entering pass in the top and downward through a nickel sleeve to the lower end of which the catalyst is attached. This is made of 80-mesh gauze of four layers, using a platinum-rhodium alloy wire (Baker No. 750 alloy), 0.003 in. in diameter.

The gauze of the cylinder is closed at the lower end by means of a silica disk so that gas flow is entirely outward through the sides of the screen. At the bright cherry-red temperature of operation, about 900 deg. C., the conversion efficiency is about 95 to 96 per cent. For the 4x7-in. screen used in the smaller units a life of from six months to one year may be expected, depending on the rate at which it has been operated.

High chrome iron is the material used for transporting the oxides from the converter. Gas is passed out of

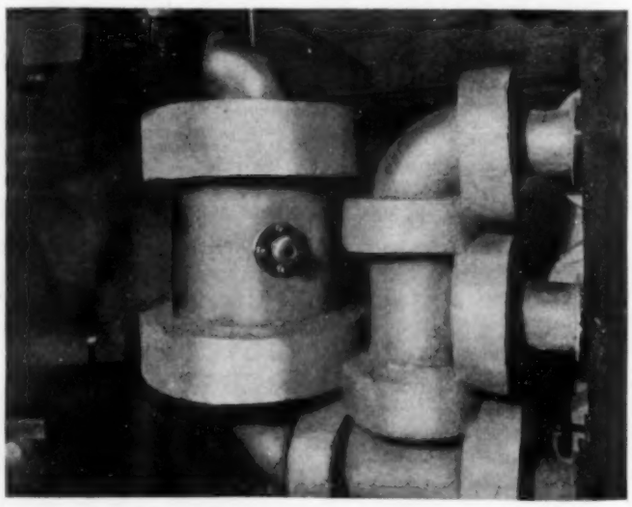


Fig. 6—Converter and Heat Exchanger Manifold. Note Sight Glass in Converter

the bottom of the converter chamber to a manifold connecting with the three branches of the heat exchanger, the inner pipes of which are of chrome iron. The oxides are partially cooled after traversing the vaporizer and are delivered directly into the Glover tower. The rate of addition of nitrogen oxides to the chamber plant per day is equal to about 15 per cent of the total nitre in circulation.

The units are very easily controlled. No special supervision is necessary as the ordinary chamber oper-

ator is quite capable of making the necessary adjustments. Once the quantity of air and ammonia is regulated to give the desired 10 per cent ammonia concentration, the only factor that may need further adjustment is the temperature of the gases as they enter the converter. This is determined by means of a thermometer inserted in the pipe shortly before the gases reach the catalyst. The temperature is maintained at about 250 deg. C. at this point. In the smaller units radiation is such that the temperature is kept within the allowable range without any adjustment. That is, assuming the correct rate of ammonia combustion, heat transferred to the incoming gases will be just about sufficient to maintain the proper gauze temperature. In the larger units an additional control is provided by bypassing part of the hot oxides around the heat exchanger.

AN ACID PLANT, when operating correctly, will require a uniform addition of nitre, the quantity of which depends upon the constants of the plant, to compensate for stack losses and the minute quantity of oxides absorbed in the product. However, occasionally careless operation or other circumstances will give rise to a deficiency of nitre or a surplus, i.e., a "red stack," when a greater or smaller flow of nitrogen oxides must be admitted to the system. The few plants in the country, now using nitric acid directly admitted to the Glover tower, have the most ready control in this respect. Plants which pot nitre have the most difficult regulation in that nitre potting at best is a more or less intermittent operation and not one capable of close control. The ammonia oxidation system is nearly as easy to step up to meet a sudden demand as is the direct addition of nitric acid; it is obviously much cheaper as well.

When the extra demand appears, it is only necessary for the operator of an oxidation unit to increase his ammonia rate to the proper figure as shown by the flow meter, at the same time increasing the air supply so as to maintain the gas composition constant as shown by the Ranarex. When the extra demand has again decreased to the average, it is only necessary to reduce the ammonia and air flow to the original values. These operations are readily carried out with the control equipment provided. Furnishing as the unit does, accurate automatic control of ammonia flow, operation practically takes care of itself under normal circumstances, except for occasional check of the flow, composition and temperature of the gases.

In consideration of the greater accuracy of technical control made possible by the use of ammonia oxidation units, and the substantial saving in operating cost over potting Chile nitrate, it would seem that chamber operators would do well to investigate the various new oxidizing units more thoroughly than is possible from a reading of the foregoing and other published descriptions.

In conclusion, the writer wishes to acknowledge the valuable assistance of Mr. J. R. Mecredy, chemical supervisor of acid plants, and other officials of the Davison Chemical Company; and of Mr. E. A. Hedin of the DuPont Ammonia Corporation.

A large map, published by, and available from the Petroleum Economics Division of the U. S. Department of Commerce at Washington, shows the natural gas pipe lines of the United States. Carbon black and natural gasoline plants are also shown. The size of the map is 48 x 76 inches.

Wear Resistance of Dies Studied

ABRASIVE ACTION of plastic clay in flowing through dies wears the liners rapidly and makes necessary frequent renewals. Although it is well known that different metals show different resistances to the abrasion of plastic clay, no data appear to be available showing the relative "wear values" of different metals, such as those used for lining dies. Such an investigation has therefore been undertaken by the government.

The work includes tests on different kinds of cast iron, steel, and bronze. Up to the present time ten tests have been made on cast iron and 44 on carbon-chrome steel. Weight loss for a definite volume of clay is determined for each test.

A very small decrease in water content of the clay produces a marked increase in the pressure necessary to extrude the clay at a definite rate, and the abrasive loss of the die increases with the extrusion pressure. The data obtained from 54 tests indicate that the relation between extrusion pressure and abrasion loss of the metal is a straight-line function according to the equation $\frac{PS}{W} = K$ in which P is the extrusion pressure, W the loss of the metal in weight, S the specific gravity of the metal, and K is a constant characteristic of the wearing quality of the metal.

Metals of highest resistance to abrasion will give the highest K values. The value of K for the cast iron die as compared to that for the carbon-chrome steel die is as 1 to 10.116 which indicates that clay can be extruded from a carbon-chrome steel die ten times longer than from a cast iron die for equal wear.

Chromium Plated Ball Mill Chips Under Impact

By John Gross and S. R. Zimmerley

Respectively, Metallurgist and Assistant Metallurgist, U. S. Bureau of Mines, Intermountain Experiment Station, Salt Lake City, Utah

TO FULFILL certain experimental conditions in the ball-milling investigation at the U. S. Bureau of Mines Intermountain Experiment Station at Salt Lake City, the inside of a 12-in. ball mill was chromium plated. The shell of the mill was standard 12-in. wrought-iron pipe with flanged ends. The plating was carried on under the conditions recommended by Haring and Barrows in the U. S. Bureau of Standards Technical Paper 346, with the exception that a current density of about 20 amperes per square decimeter was used, to give a surface of extreme hardness. The plating was carried on for six hours, and the finished surface was very hard, was adherent, and had a slightly frosted appearance.

This mill was run for 20 minutes, using a 140-lb. ball charge ranging from ½ to 1½ in. in size, and 16 pounds of coarse quartz. At the expiration of the test more than 25 per cent of the chromium plating had been chipped off. The surface was sufficiently hard to resist the abrasive action of the quartz; however, because of brittleness, the chromium plating did not withstand the shock of the impact of the steel balls.

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Viscosity Variations of Oils With Temperature

By E. W. Dean and G. H. B. Davis
Standard Oil Development Company, Bayonne, N. J.

VISCOSITY is recognized by the refiner and user as the most important single characteristic of a lubricating oil, but its significance is complicated by the fact that the temperature-coefficient of viscosity varies widely with different types of oil. The measurement and expression of viscosity is satisfactorily standardized but none of the various schemes which are generally used to indicate viscosity-temperature coefficients combines the desirable features of practical simplicity and quantitative accuracy. The system described in this paper is believed to embody these factors; it has been used for over a year by the various units of the Standard Oil Company (New Jersey) and has proven equally satisfactory to technical and non-technical men.

This system of classification permits expressing the viscosity-temperature coefficient of an oil as a simple function of its Saybolt Universal viscosities at 100 and 210 deg. F. This function, hereafter referred to as the "viscosity index," is independent of the actual viscosity of the oil in question and has the nature of a constitutive property: in other words, the viscosity indexes of all lubricating fractions, separated or refined by conventional methods from any given crude, ordinarily are approximately constant.

Basic figures used in developing the system of viscosity indexes were obtained by accurate tests of two series of lubricating oil samples, each derived from an extreme type of crude oil. The oils having a small change of viscosity with temperature are here designated as Series H, and the oils having a large viscosity coefficient as Series L.

Saybolt Universal viscosities of all of the samples were determined carefully at each of the standard temperatures of 100 and 210 deg. F. (Table I). It was found that the general relationship between viscosities at 100 and 210 deg. F., for each series of samples, could be expressed by equations of the general form: $Y = a + bx + cx^2$, in which Y = viscosity at 100 deg. F. and x = viscosity at 210 deg. F. Constants a, b, and c are characteristic of the series of oils. Their values were calculated for each series of samples, using the method of least squares. The equations are as follows:

$$\text{Series H:}\quad Y = 0.0408x^2 + 12.568x - 475.4$$
$$\text{Series L:}\quad Y = 0.216x^2 + 12.07x - 721.2$$

Viscosities calculated by the above equations are shown in Table I, compared with the experimentally determined values.

Table I—Experimentally Determined and Calculated Saybolt Universal Viscosities of Selected Series of Lubricating Oils

Series H			Series L		
Vis. at 210 Deg. F.	Vis. at 100 Deg. F. Exper.	Vis. at 100 Deg. F. Calc.	Vis. at 210 Deg. F.	Vis. at 100 Deg. F. Exper.	Vis. at 100 Deg. F. Calc.
49.0	242.5	238.5	42.0	180.0	166.7
53.5	313.0	313.9	46.0	280.0	291.0
59.5	414.0	417.0	50.0	420.0	422.0
67.0	545.0	550.0	55.0	570.0	596.1
76.5	727.5	725.0	59.0	750.0	742.8
89.0	971.5	966.2	63.0	930.0	896.5
105.0	1,292.0	1,294.5	71.0	1,210.0	1,224.5

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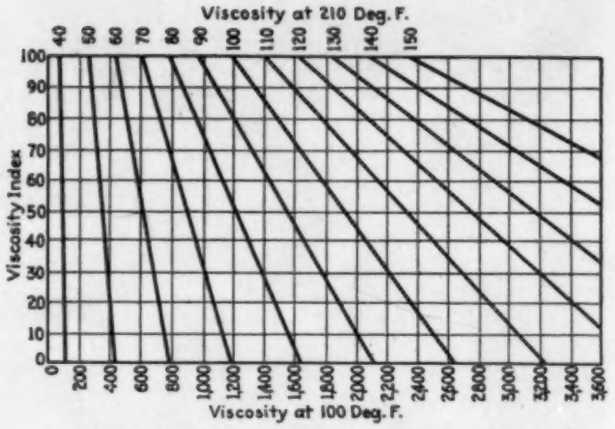

Fig. 1—Graphic Estimation of Viscosity Index

From equations above, Table II has been prepared to show the equivalent viscosity at 100 deg. of each series of oils, for every viscosity at 210 deg. from 40 to 160. Table II also includes for each viscosity at 210 deg. a figure representing the difference between the calculated viscosities of the Series L and Series H oils. From this table has been developed a system of so-called viscosity indexes which indicate the viscosity-temperature coefficients of oils on a scale in which the Series L oils are taken as 0 and the Series H oils are taken as 100. The viscosity index of an oil can be calculated by the equation:

$$V.I. = \frac{L - U}{L - H} \times 100,$$

where $V.I.$ = viscosity index; U = viscosity at 100

Table II—Viscosity Data at 100 Deg. of Series H and L Oils for Viscosities at 210 Deg. F.

Visc. at 210 Deg.	Visc. at 100 Deg. Series H	Visc. at 100 Deg. Series L	Visc. Difference L—H = D	Visc. at 210 Deg. F.	Visc. at 100 Deg. F. Series H	Visc. at 100 Deg. F. Series L	Visc. Difference L—H = D	Visc. at 210 Deg. F.	Visc. at 100 Deg. F. Series H	Visc. at 100 Deg. F. Series L	Visc. Difference L—H = D
40	93	107	14								
41	109	137	28	81	810	1,674	864	121	1,643	3,902	2,259
42	124	167	43	82	829	1,721	892	122	1,665	3,966	2,301
43	140	197	57	83	849	1,769	920	123	1,688	4,031	2,343
44	157	228	71	84	868	1,817	949	124	1,710	4,097	2,387
45	173	261	88	85	888	1,865	977	125	1,733	4,163	2,430
46	189	291	102	86	907	1,914	1,007	126	1,756	4,229	2,473
47	205	325	120	87	927	1,964	1,037	127	1,779	4,296	2,517
48	222	356	134	88	947	2,014	1,067	128	1,802	4,363	2,561
49	238	389	151	89	966	2,064	1,098	129	1,825	4,430	2,605
50	255	422	167	90	986	2,115	1,129	130	1,848	4,498	2,650
51	272	456	184	91	1,006	2,166	1,160	131	1,871	4,567	2,696
52	288	491	203	92	1,026	2,217	1,191	132	1,894	4,636	2,742
53	305	525	220	93	1,046	2,270	1,224	133	1,918	4,705	2,787
54	322	561	239	94	1,066	2,322	1,256	134	1,941	4,775	2,834
55	339	596	259	95	1,087	2,375	1,288	135	1,965	4,845	2,880
56	356	632	276	96	1,107	2,428	1,321	136	1,988	4,915	2,927
57	374	669	295	97	1,128	2,481	1,353	137	2,012	4,986	2,974
58	391	706	315	98	1,148	2,536	1,388	138	2,036	5,058	3,022
59	408	743	335	99	1,168	2,591	1,423	139	2,060	5,130	3,070
60	426	781	355	100	1,189	2,646	1,457	140	2,084	5,202	3,118
61	443	819	376	101	1,210	2,701	1,491	141	2,108	5,275	3,167
62	461	857	396	102	1,231	2,757	1,526	142	2,132	5,348	3,216
63	478	897	419	103	1,252	2,814	1,562	143	2,156	5,422	3,266
64	496	936	440	104	1,273	2,870	1,597	144	2,180	5,496	3,316
65	514	976	462	105	1,294	2,928	1,634	145	2,205	5,570	3,365
66	532	1,016	434	106	1,315	2,985	1,670	146	2,229	5,645	3,416
67	550	1,057	507	107	1,337	3,043	1,706	147	2,254	5,721	3,467
68	568	1,098	530	108	1,358	3,102	1,744	148	2,278	5,796	3,518
69	586	1,140	554	109	1,379	3,161	1,782	149	2,303	5,873	3,570
70	604	1,182	578	110	1,401	3,220	1,819	150	2,328	5,949	3,621
71	623	1,225	602	111	1,422	3,280	1,858	151	2,353	6,026	3,673
72	641	1,268	627	112	1,444	3,340	1,896	152	2,378	6,104	3,726
73	660	1,311	651	113	1,466	3,400	1,934	153	2,403	6,182	3,779
74	678	1,355	677	114	1,488	3,462	1,974	154	2,428	6,260	3,832
75	697	1,399	702	115	1,510	3,524	2,014	155	2,453	6,339	3,886
76	716	1,444	728	116	1,532	3,585	2,053	156	2,478	6,418	3,940
77	734	1,489	755	117	1,554	3,648	2,094	157	2,503	6,498	3,995
78	753	1,534	781	118	1,576	3,711	2,135	158	2,529	6,578	4,049
79	772	1,580	808	119	1,598	3,774	2,176	159	2,554	6,659	4,105
80	791	1,627	836	120	1,620	3,838	2,218	160	2,580	6,740	4,160

deg. F. of the oil in question; L, H = respectively, the viscosities at 100 deg. of the Series L and Series H oils having the same viscosity at 210 deg. as the oil in question.—The equation can be used more conveniently in the form $V.I. = \frac{L - U}{D} \times 100$, in which $D = L - H$. The values of D are included in Table II.

The following example illustrates the method of calculating the viscosity index of an oil having a viscosity of 60 at 210 deg. and 600 at 100 deg.

$$V.I. = \frac{781 - 600}{781 - 426} \times 100 = \frac{181}{355} \times 100 = 51$$

The possibility of estimating viscosity indexes, without making arithmetical calculations based on Table II, is shown in Fig. 1. The example cited above is solved by following the oblique line marked 60 until it crosses the vertical line marked 600, then following a horizontal line to the viscosity index scale appearing at the end of the chart. This chart, incidentally, indicates a degree of accuracy above the experimental value and an unavoidable exaggeration of the importance of differences in viscosity indexes for the lower viscosity oils.

How to Write in English Without "English"

By James H. Collins

Arthur R. Maas Chemical Laboratories, Los Angeles, Calif.

WHY should a technical man learn to write for the layman—and how can he do it? Some years ago, I spoke to the engineering class at the Sheffield Scientific School of Yale; that was the subject. And I advised the students to adopt the letter form as a means of breaking down the great obstacle of all writers (even hardened professionals)—self-consciousness.

"Cultivate the habit of writing letters about your work," I said. "You can begin even a report with 'Dear Al,' and write something to yourself which, when revised, will have the breath of life in it."

"That sounds sensible," declared Professor Breckenridge, "but the deuce of it is, when we engineers write anything, it goes over to the English department, and comes back marked about 65 for grammar!"

I believe this is the procedure in most institutions that teach the technical man to write. Most of the books on technical writing pay a great deal of attention to form and correctness. Which is just too bad!

For a technical man's writing has nothing whatever to do with grammar, or literary style, or form, or even "English." The chemical engineer, electrical engineer, petroleum geologist and other technicians in applied science are helping make the world go round. Just what they do, is often of real interest to the general public. If they can tell how they do it, on paper, clearly, they become more useful technologists.

To set students studying essays by Addison, Poe, De Quincey and Emerson, is to get far from the practical purpose. If these "classics" were alive now, in our fascinating world, they would write in ways so different that the English department would rate them very low indeed. If the technologist could learn to write like a classic, and attain 100 per cent on grammar, he would be so dull that no layman would read him.

Proper models for the technologist of 1929 would be Ring Lardner and Milt Gross, who have a directness which is the tempo of our age. How little grammar, or even "correct" English, has to do with clear expression of what one wants to say, can be seen in those examples of Japanese or Babu writing so often published as humor. Note that no matter how the Japanese schoolboy or the unquenchable Babu scrambles the English language, there is never any doubt about what he wants to say.

That is all a technical man wants to do in writing—say something. His fellow-townsmen want him to say a mouthful in the Sunday supplement about the wonders of fermentation as utilized at the local pickle works. His fellow-countrymen wish to get the "low down" from him on this new hydrogenation stuff from Germany—what will it do to the oil business?

All the technical man needs for his writing is a scenario. When he writes a report for his employer or client, he uses one. The facts are grouped under such headings as History of Soap, Materials used in Modern Soap-making, Agents of Saponification, Action of Soap, By-products of Soap, Probable Costs of Soap in Greater Zenith. No matter how technical even a report may be, it can have a movement—say, from the earliest days of soap, to the marvels of the present-day shaving cream. That is a scenario, a mold into which to pour his knowledge of soap, and for the purpose of a popular article, he has only to write "Dear Alice: You ask me why I am satisfied to apply my abilities to the soap works here in Zenith. Do you realize that down through the ages soap has been of incalculable value to mankind? Let me briefly explain what soap——"

And he is off (Alice, one hopes, is not), to write an article which printed in the Sunday supplement may lead the Zenith Soap Corporation to raise his salary, or wake up the local tanner or potter or gas company to the possibilities of chemical engineering.

In the days of Grub Street, when a publisher got hold of a Goldsmith, he obtained books by the simple process of taking the author's pants away, figuratively speaking, until he wrote a "Vicar of Wakefield." (If the contemporary publisher could take away the contemporary author's straight-eight, and Japanese butler, it might be a very good thing for literature.) When the chemical engineer is held down in his chair, with a pad and pencil, and kept there until he produces an article, or a book, explaining his work, the results are often gratifying.

Let us examine an article and a book recently written by chemical engineers:

After fifteen years of costly experiment, aluminum chloride has recently been brought down to five cents a pound, and in *Chem. & Met.* for July, 1929, the story of this achievement was told for chemical engineers by A. M. McAfee. Incidentally, the author wrote an article which, with a few additions and explanations, would be clear and interesting to a much wider audience.

The scenario is there, in the sense of a plot—drama. The essence of every plot, from the funny Milt Gross difficulties of Izzy, back to the labors of Hercules, is obstacles to be overcome. No obstacles, no story.

Dr. McAfee starts with aluminum chloride at a dollar and a half a pound, and rapidly goes on to tell about the first effort to cheapen the stuff, and why it was difficult,

and how the first attempt failed. He becomes the hero, as it were, and the Gulf Refining Company, spending good money, is the fairy godmother who believes in the hero. Step by step the obstacles are encountered, and overcome. The article is sound narrative, and the author probably wrote without knowing it, content to explain the developments of a process to men who would get the technicalities in a few words. That is, he wrote unhampered by self-consciousness.

A reporter for the Sunday supplement would make this a gripping lay article by merely asking, "What is this aluminum chloride stuff good for, anyway?" So Dr. McAfee would tell him that it is good for the gasoline he buys at the filling station, and good for silk stockings, and so on, and that probably it will make more jobs for people. Then the reporter would ask him to clear up a few technical terms, and that is always easy for the technician when he talks to people. If he had been asked to rewrite his paper for the high school students in Port Arthur, he would have been his own Sunday reporter.

And John E. Teeple had a scenario when he wrote his recently published book about "The Industrial Development of Searles Lake Brines." Because he had a plot, and was freed from self-consciousness, Dr. Teeple takes his reader along from battle to battle, explaining step by step the toughness of Giant This, and the subtlety of Giant That, good-naturedly accepting defeat, sympathizing with early champions who had gone that way and left their technical bones in the desert.

It is a good "Sunday story," up to the point at which he begins on his equilibrium data, and they really heighten the interest of the narrative for the layman, because he sees how dull the story might have been.

Technical men in all lines realize the need for more writing, by men who understand the technicalities, and who can make them interesting to the public. If they will forget the taboos thrown around writing at college, and merely write, for themselves, for the sake of writing, the thing can be learned, and be fun, and ability to express themselves will make them better technicians, clarifying their work step by step.

IN WRITING for lay readers, the technical man's chief obstacle is the terrific nomenclature of his specialty: the polyglot, abstract words by which he makes himself comprehensible to others of the same profession. These words mean something concrete to men of his calling, but the layman gets no mental picture from them.

Now, as a writer who has long been interviewing technical men, and explaining what they are up to so their wives will understand them, I have been struck by their clearness in a man-to-man account of their work. Ask the technician, "What causes that?" and he lays his nomenclature aside and tells you plainly. Of course, if he can tell it, he can write it.

Reading is good writing exercise. Whether you like Herodotus, Conan Doyle or the sport-page account of yesterday's game, strong clear writing drills subconsciously in the use of words. When you run across an article that impresses you particularly, set it aside, and when you want to write yourself, read it again, for a "starter."

Finally, remember that the layman wants to *feel* as well as be informed. Your fellow technician gets your equilibrium data when you catalog and chart them. But for the layman, it is necessary to show what they mean to him, to humanity; what a job it was to balance them against the indifference of Nature, the conservatism of capital, and the innate cussedness of inanimate things.

"What causes that?" asks your invisible lay audience. "What good is it, anyway? What do I get out of it?" If you go back mentally, to the very beginning, before this whole subject, now so familiar, was as fresh to you—lo! those were the very questions in your own mind!

So, to write, go back to the beginning and follow the plot.

Enlist the Chemical Engineer For Plant Safety

AMONG papers read before the 18th Annual Safety Congress, held in Chicago, Sept. 30-Oct. 4, three in particular emphasized the importance of co-ordination within the plant for the attainment of safe practices. G. H. Miller, of the du Pont Company, Wilmington, enlarged on "Plant Safety Organization," indicating how responsibility can be effectively apportioned within a large group, while F. J. O'Connor, of the du Pont dye works in Pennsgrove, N. J., described the entrance of the safety element into the modern production program and plant duties.

Dealing more specifically with the chemical engineer's part in these necessary precautionary measures, Henry L. Marsh, of the technical division of the Hercules Powder Company, Wilmington, Del., outlined three functions in which he is directly or indirectly required: fire prevention and control, transportation, and personal hazards.

But the chemical engineer's knowledge becomes of major importance in experimental control, both in the laboratory and on a larger scale. Any process worked out in the research laboratory should be carefully studied before plant scale tests are made, to unearth possible difficulties and hazards that may arise.

In this connection Mr. Marsh cites a striking example of what occurred when the laboratory findings were not thoroughly sifted: "In the formulation of a new smokeless powder, there were present the usual ingredients: nitrocellulose, diphenylamine, ether and alcohol, and in addition, an inorganic oxidizing salt. In the small-scale laboratory experiments it was their practice to dissolve the diphenylamine in the solvent and to add these two ingredients together to the nitrocellulose and oxidizing salt. No difficulty was experienced in several hundred experiments.

"The work had progressed to the place where a plant-scale experiment was desirable. Not having carefully considered the situation, no special instructions were issued to the plant, which, following the usual practice, weighed up the diphenylamine along with the oxidizing salt. The nitrocellulose and solvent were placed in the mixing bowl and for a short interval the mixer was shut down and the diphenylamine and inorganic salt dumped in loosely on top of the mixture. In a few moments a fire started which practically destroyed the building. Later experiments disclosed an exothermic reaction possible between the diphenylamine and the oxidizing salt when only moistened with alcohol, giving off enough heat to set fire to the alcohol.

"We believe that this has taught us to consider carefully all such possibilities in going from research to plant scale. The same applies to all other such operations."

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Steel Tank Cars for Phosphoric Acid

To the Editor of Chem. & Met.:

Sir—Having read the interesting article in the August issue of *Chem. & Met.*, on the manufacture of trisodium phosphate on the Pacific Coast, I should like to call your attention to a statement therein which gives to the general reader an erroneous impression of the properties of concentrated phosphoric acid.

The article by Mr. Bowman states: "The phosphoric acid is concentrated to about 50 per cent P_2O_5, at which strength it does not attack iron or steel, and is shipped in steel tank cars." Technically pure phosphoric acid of this concentration attacks iron or steel very rapidly and can not be shipped in plain steel tank cars or in any other steel containers.

It is only when the acid contains large quantities of impurities, such as pentavalent arsenic, which inhibit the attack on the metal, that it is possible to use steel tank cars for shipment.

HOWARD ADLER.
Chief Chemist,
Victor Chemical Works,
Chicago Heights, Ill.

To the Editor of Chem. & Met.:

Sir—In reply to Mr. Adler's letter pointing out that there could be misunderstanding of my statement that fifty per cent Anaconda phosphoric acid does not attack iron or steel, there is no doubt about the fact that this grade of phosphoric acid may be handled in steel as safely as sulphuric acid.

I have not heard before the explanation that Mr. Adler gives, that the arsenic present gives the acid this valuable property, having always assumed (though without experimental proof) that the two or three per cent of sulphuric acid present was the inactivating factor. An acid a few per cent weaker can not be handled in steel, no matter what impurities are present.

Mr. Adler's information is most interesting, especially regarding arsenic as the inhibitor.

FRED C. BOWMAN.
A. R. Maas Chemical Company,
Los Angeles, Calif.

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Motors in Corrosive Atmospheres

To the Editor of Chem. & Met.:

Sir:—I wish to take exception to several statements by Mr. Warner in his article, "Electrical Equipment in the Chemical Plant," appearing on page 369 of your June issue.

Referring to the third paragraph, motors should be provided with adequate lubrication but in no case should such an excess of oil be used that it will overflow into windings. Oil has sufficient action on insulation under heat even in absence of chemical fumes to destroy insulation, especially where this insulation is fiber or shellac-impregnated cotton.

Shellac readily absorbs moisture and is soluble in many non-aqueous fumes and consequently should not be used as recommended by the author. High-grade motors are impregnated with varnishes and lacquers that are not soluble in the usual chemical plant fumes; where the fumes do attack the insulation, shellac will only make the conditions worse. Shellac may be used around plants handling solvents of the usual varnishes and lacquers and with carbon tetrachloride, provided the shellac is melted in a glue pot and applied to the motor after the motor has been heated up to the melting point of the shellac. Any addition of solvent, such as alchohol, to the shellac to reduce its viscosity will render the shellac soluble to all solvents.

The only safe practice is to purchase motors designed for this severe service. The initial price is higher but the maintenance averages so much lower that in the end the cost per unit output is many times lower, even when no account is taken of the cost of production stoppage when motors fail.

H. E. WEIGHTMAN.
Drying Systems, Inc.,
Chicago, Ill.

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A Solution to the "Instrument Institute"

To the Editor of Chem. & Met.:

Sir:—Mr. Béhar's letter on page 364 of your June issue touched a matter of some interest to the writer.

Our first reaction is that Mr. Béhar has set up an outline of an organization which would be more idealistic than practical because it is very doubtful in our minds as to just how successful such an institute would be in obtaining information from the instrument manufacturers as outlined under his function (1). It would also be very difficult to get the various industrial companies to submit solutions of their own problems and thereby benefit some of their competitors who might be only too glad to use information of the type submitted without contributing in a like manner.

We believe that what Mr. Béhar suggests under function (3) is already being done to a certain extent by the individual sales engineers of the instrument companies even though no organized effort has been expended.

Work under function (4) has already been started by a committee of the Scientific Apparatus Manufacturers of America, an organization which has been organized for over ten years and includes all of the larger instrument manufacturers.

In view of their resolution, wishing to co-operate with other societies and the government in standardizing specifications, we believe that the fullest use should be made of associations already established and that it would be a waste of time and energy to organize a new association as suggested by Mr. Béhar when there is an organization qualified to handle this and similar propositions now in existence and regularly functioning.

A. W. CHASE.
Sales Engineer,
The Foxboro Company
Foxboro, Mass.

CHEMICAL ENGINEER'S BOOKSHELF

Catalytic Conclusions Abroad

CATALYTIC PROCESSES IN APPLIED CHEMISTRY. By *T. P. Hilditch.* D. Van Nostrand Company, New York, 1929. 360 pages. Price, $6.

Reviewed by D. B. KEYES

IN THE year 1651, a physicist by the name of John French wrote a book on distillation. In his introduction he made the following statement, "There is a glut of chemical literature but a dearth of chemical knowledge." This statement holds true in 1929. Opinions, ideas and theories are very entertaining to read about, but a worker in the chemical field really appreciates most of all a collection of facts. Professor Hilditch's book on catalysis is a straightforward readable statement of the facts. Very few attempts have been made by the author to "extrapolate" his data.

Practically every line of work in the chemical field today involves the use of catalysts. In fact it has been often stated that there is no such thing as a non-catalytic reaction. Professor Hilditch's book will have wide appeal to the chemical industries in this country as well as to our foreign friends. Professor Hilditch covers the field in a most excellent manner and though he hasn't gone into any great detail concerning specific cases, nevertheless he has proportioned his material in a common sense manner.

Professor Hilditch evidently has not spent much time in the United States in recent years and, therefore, is not familiar with the recent developments in this country. Notable examples which have either been treated very lightly or not at all are as follows: The manufacture of sulphuric acid using vanadium salts as a catalyst; esterification processes; liquid-phase hydrogenation of acetone; and the recent work on the partial oxidation of aromatic hydrocarbons. This does not seriously handicap the book. The reviewer would like to suggest, however, to English writers in general that a summer vacation spent in the United States might be most pleasant and profitable. In times past many of our foreign friends seem to have derived great pleasure in instructing their ignorant American brothers. The reviewer feels certain that the time has come when these same Americans would derive even greater pleasure in instructing our foreign friends.

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Technology of Rayon

ARTIFICIAL SILK. By *Franz Reinthaler;* translated, enlarged and revised by *F. M. Rowe.* D. Van Nostrand Company, New York. 276 pages. Price, $7.50.

Reviewed by THEODORE R. OLIVE

WHILE blithe guesstimators were forecasting the peak of the rayon boom back in 1920, popular favor and the continual efforts of rayon manufacturers were conspiring to prove how difficult it is to judge the possible spread of a new synthetic product. New estimates by *Textile World* place the world production for 1929 at nearly 400 million pounds, about 14 times that in the guesstimators' "peak" year.

Whether popular demand inspired the technical improvements or vice versa is a point as debatable and about as important as the matter of the priority of hen or egg. But the fact remains that the technical advances are with us and must be recognized. Herein is justification for the frequency with which new volumes of rayon lore roll off the presses, new volumes which often, on casual inspection, appear to add little to the already published literature of artificial silk manufacture.

This book is perhaps one of the most cosmopolitan in its conception yet to appear. Professor Reinthaler published his "Die Kunstseide und andere seidenglänzende Fasern" in 1926. Now, collaborating with the original author, Professor Rowe has produced a translation, which, while essentially the work of the former, is nevertheless brought up to date and considerably enlarged. The result is a volume which, to the reviewer at least, appears to present a very fair cross section of European and British practice while yet containing much that is of direct application west of the Atlantic.

Chemical technology, the whys and wherefores, are the strength of the present discussion. Much of it recognizes no international boundaries. A fair proportion is entirely new, for example the "cold" viscose and cellulose-ether processes of the Viennese chemist, Leon Lilienfeld. All of it is presented with commendable but not overwhelming thoroughness. Treatment of the viscose process is particularly apt. An additional attraction lies in the inclusion of the best collection of photomicrographs that, to the reviewer's knowledge, have yet been published on rayon.

The book is not notably strong, however, from a standpoint of pure chemical engineering, while the treatment of economics of the industry lags considerably behind such older books as that by Avram. Nevertheless, the chemist and rayon user particularly, and the engineer and economist to a lesser extent, will find that Professors Reinthaler and Rowe have carried out their avowed program in very creditable manner.

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Newly Arrived

PETROLEUM FACTS AND FIGURES. Prepared by Division of Public Relations, American Petroleum Institute. 287 pages. Price $2.—In this second, revised and extended, version, the petroleum industry can see promise of a continued annual service from its technical society. As in the 1928 edition, the subjects are grouped rather empirically, but are again inclusive and supplemented by well-assembled statistics.

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GESCHICHTE DER GESELLSCHAFT FÜR LINDE'S EISMASCHINEN A.G.—50 Jahre der kältetechnik 1879-1929. Wiesbaden. 192 pages.—Issued to commemorate the 50th anniversary of the Linde Company, this substantial and extremely handsome volume might well serve, in spite of apparent "artiness" of its make-up, as an historical textbook of refrigeration technology. The paper is excellent, hence the numerous photographs are fully informative and the drawings clean and clear. One wishes that more large industries were given to commemoration.

Selections from Recent Literature

HEAT METERS. H. Winkelmann. *Chemische Fabrik*, Sept. 18, pp. 419-20. Heat meters are a recent development, resulting from prolonged efforts to meet the demand of the heat-using process industries for a suitable instrument for measuring the heat content of a liquid current. There are two principal types, one using the whole current (Sandvoss or Sandvoss-Schilling) and the other using only a partial current (Grellert). Both types are described, and applications are cited. These include uses in chemical factories and in paper and textile mills. The meters are made for pipe diameters from 15 to 100 mm. They are useful either for steam storage systems or for hot water heating installations.

LOW TEMPERATURE EVAPORATION. Ernst Jantzen and Hans Schmalfuss. *Chemische Fabrik*, Aug. 28 and Sept. 4, pp. 387-91 and 399-401. For the evaporation of solutions of reactive substances, the temperature should be as low and the heating time as short as possible. The apparatus should be simple, not cumbersome, inexpensive, and applicable to various uses. The distillate should be recoverable. A system is described, by which evaporation can be rapidly and conveniently effected at very little above the freezing point of water. It involves the use of a high vacuum pump, if the vapor pressure of the solution is less than about 15 to 20 mm. at the chosen temperature; for higher vapor pressures, the high vacuum pump is unnecessary. The vapor is condensed by contact with cold water or ice. Specific applications are cited, and a table given, showing the temperatures at which the high vacuum pump becomes necessary for water, toluene, heptane, alcohol, benzene, methanol, chloroform, acetone and ether. Pressure and temperature calculations are also given for specified cases. A special flask can be used for liquids which tend to foam.

SPRAYING. *Chemiker-Zeitung*, Aug. 28, pp. 671-2. A recent improvement in devices for increasing the surface area of a sprayed liquid mist is the combined whirling and suction spray nozzle. This type of nozzle has a capacity range from about 0.01 to 0.5 liters per min., operating at pressure ranging upward from 0.3 atm. It may be operated by compressed air, steam or gas, of which it uses up about 500 times the volume of liquid sprayed. There are also some other new nozzle designs. Applications of these nozzles in the process industries include air conditioning, dust removal, removal of toxic matter from air or gases, spray drying and the acceleration of chemical reactions. Some materials can be dispersed to a colloidal degree of fineness. Illustrations are shown of a reaction tower, a drying installation and an apparatus for refining tar oil, utilizing the spray principle.

HETEROGENEOUS CATALYSIS. *Zeitschrift für Elektrochemie*, September, pp. 527-618. A symposium on heterogeneous catalysis was held by the Deutsche Bunsen-Gesellschaft at its Berlin Meeting, May 8-12. General papers were presented first, followed by papers on special topics. The general papers were by F. Haber, presenting four observations on heterogeneous catalysis; Max Bodenstein, influence of vessel walls; H. R. Kruyt, molecular orientation in the adsorption layer; Hugh S. Taylor, active centers; Otto Warburg, respiration ferments; F. London, a quantum mechanics interpretation of activation; M. Volmer, nuclei and their action; and M. Polanyi, activation at interfaces. Special topics were presented by Adolf Smekal, crystal defects and active centers; G. M. Schwab and E. Pietsch, experimental localization of catalytic effect; E. Pietsch, A. Kotowski and Miss G. Berend, experimental detection of adlineation; E. Rupp, use of electron waves to detect adsorbed layers; W. Frankenburger and K. Mayrhofer, atomic iron; H. Kälberer, H. Mark and C. Schuster, adsorption phenomena; J. P. Wibaut, double bond addition reactions; G. M Schwab and Miss H. Schmidt, decomposition of ammonia; Kurt Fischbeck, some heats of activation; A. Lottermoser, peroxide catalysis with tungsten; and F. F. Nord and J. Weichherz, kinetics of cell fermentation. Discussions of these papers are given. One of the most active discussions followed the papers on adlineation and on localization of catalytic effect.

TETRACHLORIDE EXTINGUISHERS. F. Wirth. *Chemiker-Zeitung*, Aug. 21, pp. 651-2. The Government Institute of Chemical Technology in Berlin has made some tests with tetrachloride fire extinguishers in a room 30x2x2 m., with an artificial wind velocity of 0.8 to 0.9 m. per sec. oil, benzol and acetylene fires were used for the tests. The observed amounts of phosgene formation were such that the hazard of using tetrachloride under any conditions where the evolved gases are not readily dissipated is considerable. For using the extinguisher, except under most favorable conditions (e.g. outdoors, with a favoring wind) use of a respirator with a phosgene absorbent is recommended. Trials are being made with addition of agents to tetrachloride to hinder phosgene formation, but these are not yet fully successful.

EMULSIFYING FATS. Kyosuke Nishizawa. *Chemische Umschau auf dem Gebiete der Fette*, Sept. 11, pp. 277-84. Different investigators have obtained discordant results as to the emulsifying power of reagents of the Twitchell type in hydrolyzing fats. A study of the causes of disagreement indicates that the emulsifying behavior is quite sensitive to experimental conditions, which were not the same in all the published investigations. Some of the principal factors which should be standardized for thoroughly concordant results are acidity, salt content, concentration of reagent, kind of acids present, fatty acid content of the oil, and additions of modifying substances such as glycerol, sodium salt of the reagent, etc. Trials are reported of variations of these conditions in hydrolyzing fats with commercial Twitchell reagents, and the results are tabulated. In general, fatty acids greatly improve the emulsifying effect, the optimum fatty acid content for this purpose being about 70 per cent. Sodium salts of the Twitchell reagents are also helpful. Glycerol has relatively little effect.

SULZER COMPRESSORS. R. W. Miller. *Canadian Chemistry & Metallurgy*, September, pp. 237-40. Increasing industrial applications of high pressures to gas reactions have created a need for compressors which will develop very high pressures with dependable precision. The major example is the production of synthetic ammonia. For this industry, whether operating by the water gas method or the Claude process, the need for a reliable, effective compressor led to the development of the Sulzer type. This is a six-stage machine, with a suction capacity up to 105,000 cu.ft. per hour, for a final pressure of 300 atm. A machine is also made with a suction capacity up to 265,000 cu.ft. per hour, for a final pressure of 27 atm. A description is given of the construction and operation of this type of compressor.

RUST AND DEPOLARIZATION. F. Tödt. *Korrosion und Metallschutz*, August, pp. 169-74. The rate of corrosion of iron depends in large measure on the depolarizing effect of the oxygen diffusing at the cathode surfaces of local electric elements. These cathode surfaces consist mainly (ignoring inhomogeneities and impurities consisting of nobler metals) of oxidized metal. In the case of iron, the oxide generally covers most of the surface. Since oxygen has a like depolarizing effect on most metal surfaces as well as on that of cathodic iron, it should be possible to measure rate of corrosion of a metal. This could be done by dipping the metal and a metal higher in the electromotive series in an electrolyte solution; the current flowing between the two metals would indicate the number of atoms dissolved away from the baser metal. This method should also be useful for measuring the corrosive or oxidizing potential of a given solution. Trials have been made of this method as a means for accelerated corrosion tests. It has the advantage, over potential measurements, of giving a direct indication of the amount of corrosion of the sample. It is anticipated that much time can be saved by using this method in the study of rates of corrosion of iron, steel and alloys, and in the evaluation of protec-

tive coatings such as chromium, cadmium, copper, zinc, tin, and the like.

AEROSOLS. A. Aström. *Svensk Kemisk Tidskrift*, August, pp. 190-203. The theory of adsorption of solids from air by adsorption agents is developed, from mathematical considerations brought out by Tolman and others. Maximum adsorption activity and capacity of an adsorbent are favored by pore fineness; but a limit is imposed on the decrease of pore diameter for practical work by the increasing tendency toward clogging as the pores become finer. Applications of the principles of adsorption are discussed with respect to separation of ammonium chloride, zinc oxide fumes, tobacco smoke, sulphuric acid fumes, dust from cement kilns and diphenylchloroarsine from aerosols in which they are contained.

PUMPS. P. Elz. *Chemische Apparatur*, Aug. 25, pp. 176-7. A comparison is made of the performance of piston and centrifugal pumps, proceeding on the premise that the piston pump is the more economical for small liquid output and high column, the centrifugal pump being preferable for large output from a short column. For instance, to pump 12 cu.m. per hour to a height of 250 m., a piston pump consumes 14 hp. and a 9-stage centrifugal pump consumes 20 hp. This difference, which is not recognized by all pump users, gives the piston pump a place in the chemical industries from which the centrifugal pump cannot displace it. The newer designs of double and triple plunger pumps, shown in diagram, largely overcome the uneven flow which is a disadvantage of the single plunger pump. Tables are given of pumping costs with piston and centrifugal pumps.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Clay, by Paul M. Tyler. Bureau of Mines Information Circular 6155. Mimeographed.

Coal-Washing Investigations, Methods, and Tests, by H. F. Yancey and Thomas Fraser. Bureau of Mines Bulletin 300. 50 cents.

Consumption of Tin in the United States During 1928, by J. B. Umhau. Bureau of Mines Information Circular 6165. Mimeographed.

Efficiency of Grinding Mills, by John Gross and S. R. Zimmerley. Bureau of Mines Serial 2952. Mimeographed.

Crushing Resistance of Minerals, by S. R. Zimmerley and John Gross. Bureau of Mines Serial 2948. Mimeographed.

Special Features of Core Drilling in the Salt Beds of Western Texas and New Mexico, by James S. Wroth. Bureau of Mines Information Circular 6156. Mimeographed.

The Canadian Gypsum Industry, by R. M. Santmyers. Bureau of Mines Information Circular 6162. Mimeographed.

British Trade in Rubber and Rubber Products, by Robert B. Macatee. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 644. 5 cents.

Leather Trade of the Netherlands, by J. Schnitzer. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 640. 10 cents.

The Marketing of Tungsten Ores and Concentrates, by J. W. Furness. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 643. 10 cents.

Iron and Steel Trade and Industry of Great Britain. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 639. 10 cents.

The French Chemical Industry and Trade in 1928, by Daniel J. Reagan. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 652. 10 cents.

American Underwriting of German Securities. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 648. 10 cents.

Industrial Machinery in Italy, by A. A. Osborne. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 638. 10 cents.

Leather Trade of Egypt, by J. Schnitzer. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 651. 5 cents.

Representative International Cartels, Combines, and Trusts, by William F. Notz. Bureau of Foreign and Domestic Commerce Trade Promotion Series 81. 15 cents.

Survey of Nonutilized Wood in North Carolina. Report of the National Committee on Wood Utilization. 20 cents.

Specifications for Motor Fuels. One page to be inserted in Bureau of Mines Technical Paper 323B, giving the U. S. Government Master Specifications for lubricants and liquid fuels. New specifications effective September 11, 1929.

Proceedings of a Board of the Chemical Warfare Service Appointed for the Purpose of Investigating Conditions Incident to the Disaster at the Cleveland Hospital Clinic, Cleveland, Ohio, on May 15, 1929. 20 cents.

Paper Specifications, Twentieth report of the Committee on Paper Specifications to the Joint Committee on Printing in Compliance with a Resolution Adopted May 15, 1928. Issued December 7, 1928. These specifications supercede the specifications previously adopted under the Federal Specifications Board of the Government. Available from the Joint Committee on Printing of the Congress of the United States.

New German Processes in Potash Chemistry, by Trade Commissioner William T. Daugherty, Berlin. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 283. Mimeographed.

Growth of the Use of Fertilizers in New Zealand, by Consul W. L. Lowrie, Wellington. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 284. Mimeographed.

Commerce Yearbook, 1929; Vol. 1—United States. A volume of statistical information concerning business conditions in the United States and its non-contiguous territories and possessions, compiled from information collected by numerous Government bureaus, trade associations, and trade journals. Part II, which will be issued shortly, will contain similar data for foreign countries.

Production statistics from 1927 Census of Manufactures — printed pamphlets for: Prime Movers, Motors, and Generators — Coal Consumed; Petroleum Refining; Wood Preserving; Tanning Materials, Natural Dyestuffs, Mordants and Assistants and Sizes: Manufactured Ice, Refrigerators and Refrigerator Cabinets (Exclusive of Mechanical Refrigerating Equipment), and Mechanical Refrigerators; and Beverages, Flavoring Extracts, and Flavoring Sirups—Malt.

Mineral production statistics for 1928—preliminary mimeographed statements from Bureau of Mines on: Pennsylvania Anthracite Coal, Portland Cement, Natural Gas, Tin, Talc, Stone, Secondary Metals, Lime, Gypsum, Clay, Metallic Cadmium, Barite and Barium Products, and Petroleum, Petroleum Products, and Natural Gasoline.

Mineral production statistics for 1927—Separate pamphlets from Bureau of Mines on: Copper, by C. E. Julihn and Helena M. Meyer, 10 cents; Gold, Silver, Copper, Lead, and Zinc in Utah, by C. N. Gerry, 10 cents; Gold, Silver, Copper, Lead, and Zinc in Arizona, by C. N. Gerry, 5 cents; and Gold and Silver, by J. P. Dunlop, 10 cents.

Mineral production statistics for 1928—Separate pamphlets from Bureau of Mines on: Carbon Black, by G. R. Hopkins and H. Backus, 5 cents; Fuller's Earth, by Jefferson Middleton, 5 cents; and Fluorspar and Cryolite, by Hubert W. Davis, 5 cents.

Mineral Resources of the United States in 1928 (Preliminary Summary). Bureau of Mines pamphlet. 20 cents.

THE PLANT NOTEBOOK
an exchange for OPERATING MEN

Determining Thermal Conductivity of Heat Insulating Materials

By H. Stiles
Department of Physics,
Iowa State College, Ames, Iowa

BECAUSE of the rapid depletion of the lumber supply and its consequent high price, a great deal of attention has been given during the last decade to the possibility of making good lumber substitutes for building purposes. One of the results has been that during recent years a number of plants have sprung up in various parts of the country which are devoting their attention to the manufacture of insulating lumber out of what would otherwise be largely waste material. The manufacture of Celotex, Maizewood, Masonite, Insulite, Insoboard and others serve as good illustrations.

The majority of these plants are operating with no plant control of the insulating qualities of their boards. The standard practice is to send, from time to time, a sample of board to engineering or research laboratories to obtain a value of its insulating properties, for use largely in advertising literature.

These determinations usually require a minimum of a week from the time the samples are submitted until a return value is obtained. Obviously this practice does not lend itself to satisfactory plant control. There is need for an apparatus which will enable the operator to know the insulating value of his board within a few hours after the board is delivered from the saws at the plant.

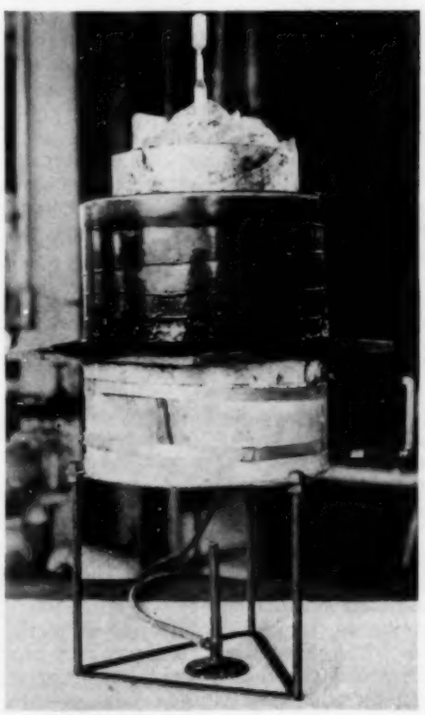
Since, as in the case of the most control work, relative values are perfectly satisfactory for purposes of operation, the piece of apparatus for determining heat transfer described below will serve admirably for the purpose. It has the added advantage that plant operators can be trained to use the method quite satisfactorily.

DURING the past ten years a very determined effort has been made by the chemical engineering department of Iowa State College to perfect a wallboard made from cornstalks. Results obtained point to a very satisfactory culmination of the project, which will not only help to solve the lumber problem but will at the same time provide a sale for quantities of cornstalks which have in the past been of but little value to the farmer.

One of the most important properties required of wallboard is good heat insulation. The determination of this factor led the writer to undertake the work described in this paper. The apparatus was designed by the writer primarily for the purpose of testing the heat insulating properties of wallboard and certain other products made from cornstalks in the chemical engineering laboratories of Iowa State College.

The completed apparatus appears in the photograph in Fig. 1 while the essential parts are shown in vertical section in Fig. 2. The cylindrical sides of the boiler and ice container are of galvanized iron lagged with asbestos. The bottom of each and the top of the boiler are brass plates $\frac{3}{16}$ in. thick. The boiler and ice container would be more durable if copper alone were used. The boiler is supplied with a water gage and two holes near the top for a thermometer and a steam outlet.

Fig. 1—Completed Thermal Conductivity Apparatus Designed by the Author Making Test on Wallboard



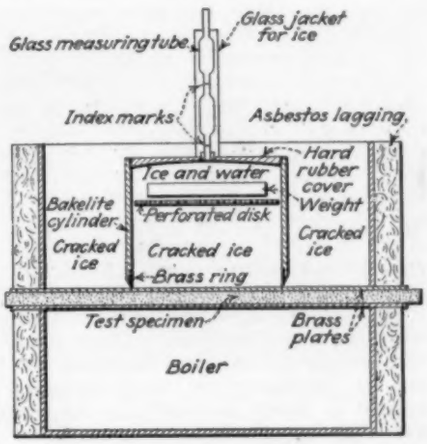


Fig. 2—Essential Parts of the Thermal Conductivity Apparatus

By means of a cylinder of Bakelite, co-axially placed, the ice container is divided into two compartments, the outer compartment, which is about 3 in. wide, serving as a guard ring. Because of its low thermal conductivity, Bakelite was used to lessen the possibility of the transfer of heat into the cylinder. With proper precautions, an all-metal cylinder could be used. The cylinder is mounted on a short, thin brass ring which is soldered to the bottom of the container. The top of the cylinder is machined out for a short distance down on the inside so as to contain a brass sleeve which is threaded to mesh with the threads on the edge of the hard rubber disk serving as a lid for the cylinder. The lid is slightly concave on the lower side and has a hole in its center into which may be fitted a one-hole rubber stopper. Into this stopper is passed a glass tube the upper part of which has two bulbs.

Two fine index marks are etched on the tube, one above and the other below the lower bulb. A larger glass tube surrounding the bulbs serves as an ice jacket.

PROCEDURE is as follows: The test specimen is clamped between the boiler and the ice container with just enough pressure to make a good contact. Cracked ice, which has been standing at least 24 hours in an ice box, is placed in the cylinder together with a metal weight and the lid is put on. The cylinder is then completely surrounded with ice and allowed to stand on the boiler for about two hours. By this time the cylinder and its contents should be at a temperature of 32 deg. F., and a fairly uniform temperature gradient established in the specimen. Enough ice and ice water are then taken from the outer compartment and placed in

the cylinder nearly to fill the latter. The contents of the cylinder are carefully stirred to dislodge any air bubbles. A thin, perforated disk is then placed on the ice with the weight on top to keep the ice against the bottom. The ice in the outer compartment also is weighted.

The cylinder lid is screwed down tightly against a rubber gasket, forcing any air and the surplus water up through the hole. The tube and bulbs are filled with ice water after which the rubber stopper is tightly inserted into the hole in the lid. Ice is then put in the ice jacket and the cylinder again covered with ice.

As the ice melts in the cylinder the water level in the tube gradually falls, the time being carefully noted when the level reaches each of the two marks. After the level has reached the lower etched mark the tube is again filled with ice water, the cylinder is again covered with ice, and a second run is made with the same specimen. Only about five minutes is required to make this change. Because of the size of the guard ring it is safely assumed that no heat can pass into the cylinder from below except that which comes vertically up through the specimen. Only very clear ice free from air bubbles should be used.

IN AN actual case all measurements were made in c.g.s. units. The specific gravity of ice was taken as 0.9164. Evidently, for every 0.9164 grams of ice melted in the cylinder there would be a volume shrinkage of approximately 0.0836 c.c. and the water in the tube would decrease by that amount.

The volume of ice water contained by the lower bulb between the two marks was carefully determined and for one of the tubes used was found to be 8.886 c.c. Therefore $(8.886 \div 0.0836) \times 0.9164$ equals the number of grams of ice melted in the cylinder during the test. With the heat of fusion of ice taken as 79.8 calories per gram, the total quantity of heat, Q, passing into the cylinder during the test run, would be $(8.886 \div 0.0836) \times 0.9164 \times 79.8 = 7765$ calories. This figure was taken as a constant for all tests made with this particular tube. The thermal conductivity, k, of the specimen was then easily calculated from the well-known equation,

$$k = \frac{Qd}{A \quad T \quad (t_1 - t_2)}$$

where d is the thickness of the specimen; A the area under the cylinder; T the time in seconds; t_1 and t_2 the temperatures of the lower and upper surfaces of the specimen. Since all of these quantities can be measured with a considerable degree of precision, the value of k is quite accurately determined.

Some observers have found that the value of k is a function of the temperature, in some cases increasing 0.2 per cent to 0.35 per cent for each degree Fahrenheit rise above a mean temperature of about 50 deg. F. As the mean temperature of the specimen in all of the tests given in Table I was about 121 deg. F., these results are evidently higher than would have been the case if the mean temperature of the specimen had been 50 or 60 deg. F.

Table I—Thermal Conductivity of Various Samples of Wallboard

Specimen	Thermal Conductivity k	Specimen	Thermal Conductivity k
1	0.411 0.423	6	0.443 0.443
2	0.384 0.397	7	0.28 .....
3	0.356 0.355 0.356	8	0.444 0.444 .....
4	0.389 0.389	9	0.403 0.412
5	0.377 0.382 0.382	10	0.395 0.407 .....

THE WRITER is now designing a substitute for the boiler which he believes will make tests possible for any desired mean temperature of the specimen below 121 deg. F.

The first six specimens in the table consist of various grades of wallboard made from cornstalks. Specimen 7 was made from cornstalk pith. Numbers 8, 9, and 10 are well-known commercial wallboards. The value of k is given in B.t.u. per hour per square foot for a temperature gradient of one degree Fahrenheit per inch of thickness. These values were obtained from the c.g.s. values of k, by using the conversion factor 2903.

None of the specimens used was oven-dried. The tests made on Numbers 8 and 6, the latter a compressed cornstalk product, were made late in June at a time when the humidity was high, so these results are doubtless relatively high because of excessive moisture in the board.

New Belt Dressings Reduce Fire Hazards

INDUSTRIES which suffer from hazards incident to the presence of flammable gases, vapors and dusts will be interested to learn of work on the control of sparking from power belts which has recently been completed by the Chemical Engineering Division of the U. S. Bureau of Chemistry and Soils. This work was carried out by P. W. Edwards and J. O. Reed under the direction of D. J. Price, in charge of the Division.

Static electricity is generated on a moving belt, and the voltage may sometimes be considerable. One of the belts used in the tests registered a potential of 40,000 volts. The charges may be built up by one or all of three methods: Friction of the belt on the pulley, the separation of the belt from the pulley, and by friction of the atmosphere on the belt. The principal source of charges under normal operating conditions, according to the investigators, is the separation of the belt from the pulley. The pulley is commonly a conductor of electricity and if grounded will not retain its charge. The belt, however, is usually a non-conductor, and the potential may under some circumstances build up until sparking occurs.

Various expedients have been used to conduct static charges from moving belts, the most common having been the use of a metal brush in contact with the belt and connected to some grounded object. Other methods include humidifying the air sufficiently, ionizing the air in contact with the belt or other surface by means of a gas flame or by the silent discharge of high frequency and high voltage current.

Static electricity can also be eliminated by special belt dressings, the requirements for which are: (1) They must have sufficient electrical conductivity to remove or neutralize static electrical charges as rapidly as they are formed; (2) they should be of such a nature that they can be easily applied; (3) they should resist wear; (4) they should not decrease the coefficient of friction of the belt on the pulley, and (5) they should not be injurious to the belt. The work of the Bureau took the tack that an electrically conducting belt would be the most satisfactory and certain way of dissipating the charge.

A metallic belt is not often feasible, so the investigators endeavored to find a method of making a rubber or leather belt a conductor of electricity. After many trials they found that if a conducting powder such as aluminum, bronze or copper were added to a good grade of spar varnish used to hold the powder on the belt the conduction of rubber belts would be adequate. Lamp black proved to be the most practical conducting dust, and spar varnish, the thinner of which consists of a mixture of mineral spirits and carbon tetrachloride, gave a preparation which would not flame and cause a fire risk. A good rubber-belt dressing can be prepared by mixing 18 parts of lamp black with 82 parts of good spar varnish. A smaller quantity of lamp black may prevent most of the cracking which develops after the dressing is used for several months. The dressing must dry on the belt before running. This has proved to be a satisfactory non-static dressing for rubber belts, but not for leather.

A non-static leather-belt dressing which has considerable merit consists of 100 cc. liquid fish glue, 80 cc. glycerine, 100 cc. sulphonated castor oil, 170 cc. water, 82 grams lamp black, and 20 cc. of 2 per cent ammonium hydroxide. These proportions may not be the best for all conditions; in some cases better results will probably be obtained by increasing the quantities of fish glue and glycerine. This dressing may be easily applied with a brush while the belt is moving. It is not necessary for the dressing to dry before operation.

If the belt has not been well cared for before the non-static dressing is applied it may cause the belt to stretch, and several applications may be required before the belt will give entirely satisfactory service.

EQUIPMENT NEWS *from* MAKER *and* USER

Direct Heat Dryer

A NEW British development, the Pehrson Dryer, is now being marketed in the United States by the Technical Economist Corporation, 122 E. 42nd St., New York City. A number of these dryers have recently been installed in Europe in diameters up to 11 ft. 2 in. and in lengths to 32 ft. 9 in. The materials being treated at present are washing soda crystals, cocoa beans, wood chips, bark, charcoal breeze, peat and coal. Tests have shown that the dryer operates satisfactorily on a considerable range of other granular or lump materials.

The new dryer consists of a cylindrical shell, around the inner periphery of which are arranged gas passages communicating with the interior through louvres extending lengthwise of the shell. The design of these louvres is such that material within the shell, as is shown in the drawing, will not fall into the gas passages while the drum is rotating.

As the drum slowly rotates, the material is carried well up on one side, as shown, and continually tumbles down the incline as rotation continues. Hot gases for drying are introduced into the gas passages in the region directly under the mass of material to be dried. This is accomplished by means of a surface-valve type of arrangement, similar to the method by which suction is applied to the leaves of a rotary vacuum filter. That is, the hot gases are discharged into only such gas passages as are beneath the pile of material being dried. As there is no communication between gas passages, none of the gas is short-circuited, but all must pass up through the bed of material.

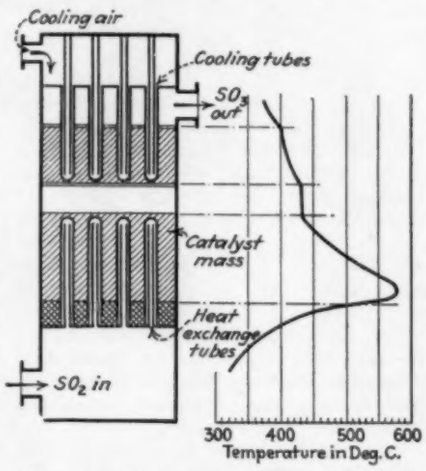
It is claimed that this system permits the use of a dryer which is smaller for a given capacity than any other type of direct-heat dryer. Another claim is one of very high efficiency. An additional feature is the close control said to be possible through the use of forced circulation and the re-circulation of a part of the gas supplied.

In operation, the material under treatment is fed to the charging end and travels under the influence of the sloping louvres and the rotation to the discharge end. A cooling section may be added if necessary.

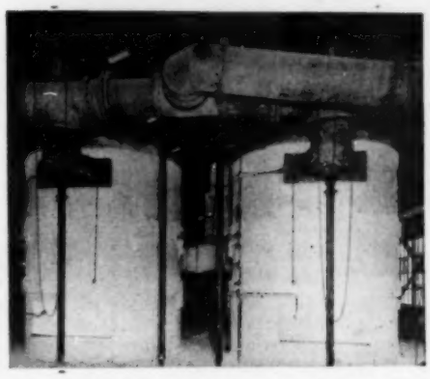
Contact H_2SO_4 System

INFORMATION concerning the new vanadium catalysts for sulphuric acid production has been available for more than a year, but it is only recently that data covering the new converter developed by A. O. Jaeger of the Selden Company, Pittsburgh, Pa., has been made known.

The primary improvement in the new contact system is, of course, the vanadium catalyst used. However, the converter itself has been improved so that it is said that much better heat control is possible than with the older Grillo and Tentelew plants. The converter system is divided into two or more converters in series placed one above the other in order to conserve floor space. In the first converter cooling elements are embedded in a layer of contact mass. These cooling elements consist of closed-end tubes within which are concentric open-end tubes. The entering mixture of sulphur dioxide and air passes in through the center tube and returns through the outer tube, which is in contact with the catalyst mass, before entering the catalyst proper. This results in preheating of the incoming gases and the cooling of the reaction gases. It is claimed that the high velocity of flow through the cooling elements results in high heat-transfer efficiency and that variation in flow will result in a change of heat transfer in the same order so that the converter temperature will remain constant. Distribution of the cooling elements varies from the center to the periphery of the converter to compensate for radiation from the outside. It is claimed that a uniform temperature is maintained across any horizontal section of the catalyst mass.



Schematic Section of Selden Automatic Heat-Exchange Converter in Series with Air-Cooled Converter. Curve Shows Temperature Variation Through Converter Unit Using 7 to 8 Per Cent SO_2 Gas

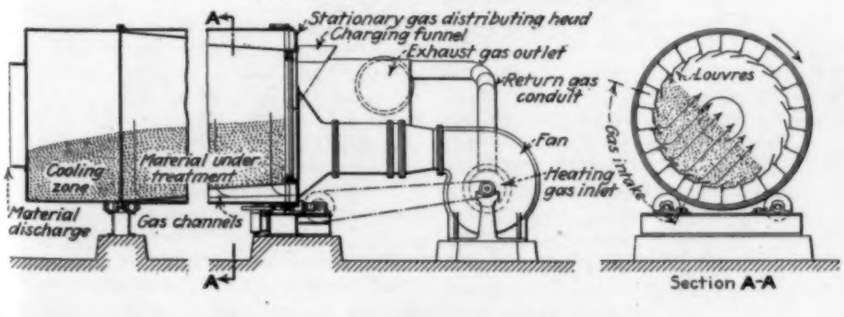


Two 40-Ton Converters in Operation

A second converter provided with cooling elements which use an external cooling medium, usually air, is maintained at the relatively low temperature needed for maximum conversion equilibrium. In this converter a larger cross section of catalyst is provided to take care of the slower reaction velocity at the lesser temperature. The drawing shows these two converters connected in series and also indicates temperature of the reaction gases at various points in the converter series.

Very interesting claims are made for the new vanadium catalyst and converter. While the catalyst is practically immune to the poisons which quickly decrease the efficiency of platinum, conversion efficiencies ranging from 97½ to 98½ per cent are said to be the rule. Temperature control is said to be inherent in the system and independent of the size of units employed. It has been stated that single converter units having a daily capacity as high as 40 tons of sulphuric acid are in satisfactory operation.

Side Elevation and End Section of Pehrson Dryer Showing How Hot Gases Pass Through Material Under Treatment



Not only is the Selden system supplied for new plants, but it is claimed that it may be applied economically to existing contact converters. Plants constructed and under construction during the last year are reported to total 300,000 tons per annum. The Selden plants are built and installed by the Chemical Construction Company, Charlotte, N. C.

Horizontal Centrifuge

MANY interesting features are shown by a new bulk centrifuge which has been developed by the Sharples Specialty Company, Philadelphia, Pa. In brief, the new machine utilizes a large-diameter basket, mounted on a horizontal shaft, which may be fed and discharged while the basket is revolving at full speed. This results in greatly increased production according to the manufacturers, since the time needed to start and stop the usual type of centrifuge is eliminated.

The horizontal centrifugal is built in two types. One uses a solid basket and a continuous skimmer pipe and is known as a "decanter." This is intended to clarify liquid with the recovery of the liquid, or the suspended particles, or both. The second type is an extractor which uses a perforated basket to separate crystals or other solids from the liquid with which they are associated, and dry the product.

The decanter, shown in section at *a* in Fig. 1 is indicated to have a solid basket. Vanes are provided in the conical portion, against which the incoming liquid, containing the solid matter in suspension, is fed near the center. The liquid is thus accelerated to the basket speed as it approaches the periphery. Upon reaching the inner surface of the basket, the material in process is then subjected to the full centrifugal force generated, and the solid particles are deposited on the inner basket surface.

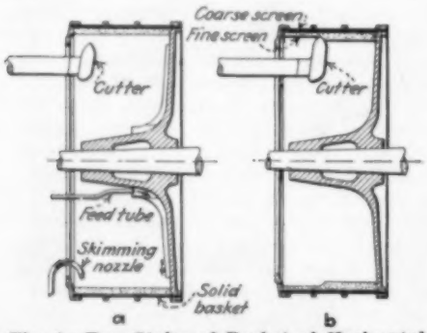


Fig. 1—Two Styles of Basket of Horizontal Centrifuge Shown in Section

At *a* is the "decanter" type, employing the solid bowl and skimmer pipe. The extractor type in *b* uses a perforated basket.

Meanwhile, the lighter liquid moves across the basket, and discharges through the skimming nozzle.

When the cake has built up to the desired point, the feed is cut off and the cake is removed while the machine is still operating at full speed. This is accomplished by a pointed cutter, which is turned toward and traverses the cake. As the solids are loosened by the cutter they fall into a hopper and are discharged out of the frame through a discharge chute. The cutter is power-driven.

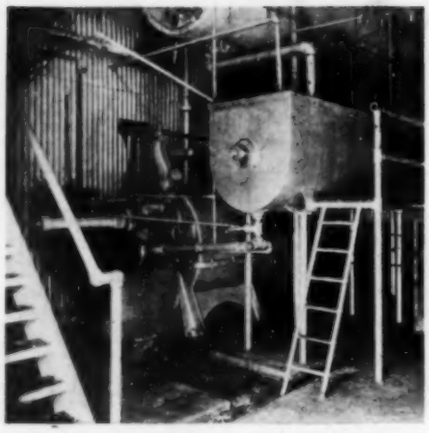


Fig. 2—Horizontal Centrifuge Operating in a Casein Plant

When the centrifugal is to operate as an extractor, a perforated basket, lined with a screen or other material suitable to the size of the crystals to be handled, is employed. Sketch *b* in Fig. 1 shows how this basket differs from the one first described. The slurry flows into the basket by means of a perforated feed pipe or overflow trough, extending across the entire width of the basket. The solids are thus evenly deposited The liquid is thrown out into the casing of the machine and drained out of the bottom. When the cake has reached its maximum thickness, the feed is cut off and the cake is whizzed to remove any excess liquor. When the cake has been dried sufficiently, the pointed cutter is used to remove it, as above described.

For cases requiring the washing of the cake, this is possible by means of a rinse pipe which is adapted to give an even spray across the entire width of the basket.

The manufacturers have found that the saving in time made by the new centrifugal, due to its continuous character, gives the machine a capacity equal to two or more of the usual type of vertical centrifugal of comparable size.

The new machine is being built in two sizes, using 48-in. and 63-in. baskets. The capacity is given for the smaller as up to 4,000 gallons per hour, and for the larger as 1 to 3 tons per hour, dependent upon the materials. Power requirements vary from 6 to 12 hp. Further, when desirable, the machine may be made fully automatic in operation so that no operator is required.

New Electrical Devices

RECENT developments announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., include a circuit breaker, an automatic welding outfit and a dust-tight line starter. The circuit breaker is a light duty device of 30 amp. capacity at 125 volts and is intended to replace fuses. It is fully inclosed and is operated by a toggle switch which is caused to release upon overload through the action of a bimetallic element. The element itself acts as a fuse link in case of mechanical failure. The timing is such that the device will release only in case an overload continues sufficiently long to be dangerous.

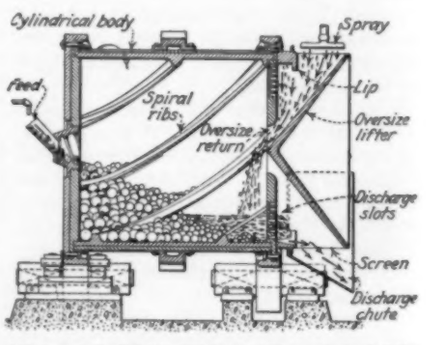
The automatic welder, known as the "Weldomatic" is of the metal arc type. The device strikes an arc and automatically feeds the electrode at the rate at which it is consumed. The new device is said to be simple and without delicate adjustments.

Remote controlled dust-tight line starters for single and polyphase squirrel-cage motors constitute the third development. Special care is taken to make the starter cabinets dust-tight and waterproof. All starters of this classification are equipped with the new deion grid type of arc quencher which is said to be the most effective arc rupturing device ever incorporated in line starters. The new starters are available in three sizes up to 50 hp. and are intended for service in coke plants, cement mills and the like.

Unique Ball Mill

WHAT IS SAID to be a very original departure in ball mill construction occurs in the new "Rib-Cone" ball mill built by the Straub Manufacturing Company, Oakland, Calif. The new mill is primarily intended for wet grinding operations but may also be used for dry grinding with equal efficiency, according to the makers.

Two features are responsible for the novel operation of this mill. One consists of the provision of spiral ribs or lifters which are attached to the lining of the shell so that the balls are carried toward the feed end of the mill as it rotates. This results in keeping the discharge end of the mill clean so that



All-Steel Ball Mill Which Utilizes Spiral Ribs

there is said to be little wear on the discharge grids which can be, due to another feature of the design, made considerably larger than the finished product.

Another function of the spiral ribs is to give a segregating action so that it is said the larger balls collect at the feed end and the smaller balls grade toward the discharge.

The sizing mechanism introduces another novel feature. The discharge end

of the mill is fitted with gratings through which the ground product and some oversize flow. The product discharges over a lip which retains the larger oversize, onto a screen which rotates with the mill. Finished material goes through the screen while oversize is carried up by means of baffles and is returned to the mill at the center of the discharge end. These features are indicated roughly in the accompanying drawing.

Among claims made for the mill, the most important are its ability to grind with a minimum of fines, its strength due to its all-steel construction which also gives a saving in weight, and low power consumption due to the rapid circulation of the load and the segregation of the balls.

Test Strips

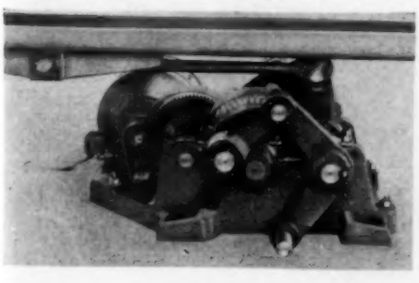
A BOOKLET containing 100 strips, 2x5 in., of transparent cellulose films for use as test panels for varnish, lacquer and paint is being marketed by R. P. Cargille, 26 Cortlandt St., New York. These are known as "Panelettes." So that they may be identified each strip carries a white spot on which it is possible to write. Glassine envelopes may be supplied for filing the panels.

Shaking-Chute Conveyor

A RECENTLY developed shaking-chute conveyor has been placed on the market by Vulcan Iron Works of Wilkes-Barre, Pa. Briefly, the new conveyor consists of a continuous trough or chute of any length up to the maximum possible with the drive mechanism used, a series of supporting carriers for the chute and a reciprocating drive mechanism. The chute may be inclined toward the discharge, run horizontally or elevated to a maximum angle of 10 per cent grade. The chute may be straight its entire length or it may be provided with joints for changing its direction by 45 deg.

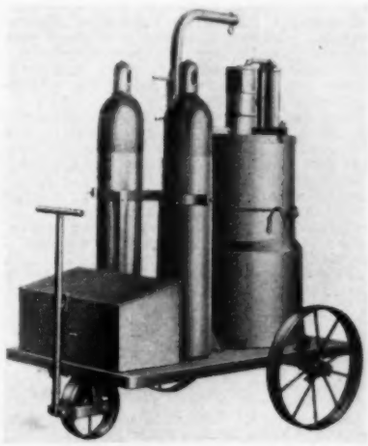
In operation the chute is moved forward with its load of material at an increasing rate which is just slow enough to prevent slippage between the material and the chute. The motion is then suddenly reversed, whereupon the momentum of the material causes it to slip forward a distance considerably in excess of the length of the stroke. The chute is returned to its starting point and then continues the cycle. It is said that this arrangement is considerably less expensive than other types of conveyors and offers the further advantage of easy relocation. Three sizes of drives are available for capacities up to 100 tons per hour with chutes ranging in width from 12 to 24 in. and in lengths up to 450 ft. The carriers may be had in wood or steel construction, with plain or roller bearings.

Section of Chute Above Drive Mechanism



Generator Trucks

TWO new trucks to accommodate respectively the types CLP-2 and CLP-3 Carbic low-pressure acetylene generators, are announced by the Oxweld Acetylene Company, 30 East 42nd St., New York. The larger one, illustrated herewith, for type CLP-3, carries two oxygen cylinders in addition to the generator, while the smaller carries one. The larger has a tool box for small tools and welding equipment, and a crane which may be collapsed out of the way when not in use for charging the generator.

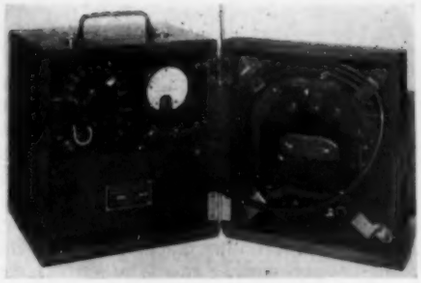


Truck for Type CLP-3 Carbic Acetylene Generator

Portable Moisture Meter

FOR rapid determination of moisture content in lumber, a meter originally developed by T. E. Heppenstall, of the Long Bell Lumber Company, is now being manufactured and distributed by C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The meter consists of a means for measuring the electrical conductivity of the lumber in question. It includes a case containing the instrument, the battery, and the control switches. Attached to the case by a cable is a flexible handle carrying two needles which are forced into the wood to serve as electrodes. The handle also carries a small incandescent lamp used in sorting out wet stock.

In operation it is simply necessary to drive the two needle points into the lumber and adjust a switch until the meter shows the passage of standard current. The position of the switch indicates per cent moisture. Or if it is desired simply to sort out all pieces which contain more than a standard amount of moisture, the small incandescent lamp referred to above will light whenever wetter stock than that for which the instrument is adjusted is tested.



Tag-Heppenstall Moisture Meter

New Electrical Equipment

NEW EQUIPMENT announced by the General Electric Company, Schenectady, N. Y., includes the following:

A device known as the Hydraulic Operator is intended to replace magnets and solenoids as well as air cylinders for moving parts of equipment by remote or other forms of control. It consists of a motor-driven centrifugal oil pump, the impeller of which is mounted in a piston and driven by means of a spline shaft. Thus the motor is stationary while the impeller is caused to force the piston through the oil. These devices are available in sizes giving 200, 300 and 600 pounds push.

The second piece of equipment, a new limit switch, designated LS-438, supersedes the various older types of cam-operated switches made by this company and combines their advantages in one device. The switch is fully inclosed and is of the snap-action type.

The third device, a new magnetic switch, CR-7006-V-7, has oil immersed contacts and is particularly adapted for gaseous atmospheres in all locations where there are highly corrosive gases or acids. It has a capacity of 40 amp. at 110 to 600 volts.

Packings for Severe Service

THREE new packings, designated as "Cutno," "Pelro" and "Palco," have been added to the manufactures of Greene, Tweed & Company, 109 Duane St., New York. The packings are intended for use on pumps and other equipment, the first for ammonia, caustic soda, hydrochloric acid, sodium carbonate and other similar materials; the second for gasoline, naphtha, alcohol and other solvents; and the third for hot and cold water and calcium chloride brine. The packings are available in sizes from $\frac{1}{8}$ to 2 in. in the braided form and in twisted form from $\frac{1}{16}$ to $\frac{1}{2}$ in.

Jordan Engine Plug

A RECENT development of John W. Bolton & Sons, Inc., Lawrence, Mass., is a bandless plug for use in Jordans. Where the knives have in the past been held into the plug by means of circular bands, the new plug makes use of knives and wooden separators which are slid into place from one end and cannot work out. The knives are so shaped that they cannot be removed from the dovetail slot in the cast steel plug body except from the end, while the wooden wedges are smaller at the top than at the bottom and must also be removed from the end. It is said that the new plug has greatly reduced maintenance over the old style.

Manufacturers' Latest Publications

Blowers. Connersville Blower Company, Connersville, Ind.—Bulletin 110—"R-S" and "R-D" blowers for medium capacity range; bulletin 201—exhausters for gas and coke plants; bulletin 305—illustrating application of Connersville gas meters.

Buildings. American Wolmanized Lumber Co., Elizabeth, N. J.—Folder describing "Wolmanized" plank and "Awico-ized" factory sash.

Chemicals. Hooker Electrochemical Co., 25 Pine St., New York, N. Y.—Well illustrated 78 page catalog and manual of information on the products of this company including alkalis, acids, salts and organic compounds. Also chemical and physical tables of a general nature.

Compressors. DeLaval Steam Turbine Co., Trenton, N. J.—Catalog F—Handbook with engineering data on this company's centrifugal compressors. General data on compression of gases.

Concrete. Ferrocrete Import Co., 250 W. 57th St., New York, N. Y.—Bulletin No. 16—Describes the application of rapid hardening cement.

Cutting. International Oxygen Co., Newark, N. J.—Folder describing "Primogas," a special compressed gas for cutting torches.

Disintegration. Sturtevant Engineers, Inc., Dorchester, Boston, Mass.—Manual "D"—24 page booklet devoted to closed-circuit grinding with classifiers.

Duriron. The Duriron Company, Dayton, Ohio.—Publications as follows: bulletin No. 154, No. 806 centrifugal pumps; bulletin No. 157, kettles and tanks; bulletin No. 158, exhaust fans; bulletin No. 159, split flanged pipe.

Electrical Equipment. General Electric Company, Schenectady, N. Y.—Publications as follows: GEA-25C, line breaker equipment; GEA-52C, outdoor station equipment; GEA-83A, inclosed magnetic reversing switches; GEA-104A, cartridge type heating units; GEA-151B, rolling mill drives; GEA-181B, inclosed magnetic switches for A.C. motors; GEA-197B, mechanical-drive turbines; GEA-211A, oil circuit breakers; GEA-241B, oil well pumping equipment; GEA-261A, electric heat in industry; GEA-532C, electric heating equipment; GEA-856B, outdoor switching equipment; GEA-957A, mechanical-drive turbines; GEA-1003A, outdoor switching equipment; GEA-1004A, outdoor switching equipment; GEA-1095A, ground clamps; GEA-1122, outdoor switching equipment; GEA-1128, steel panel switchboards; GEA-1133, mechanical-drive turbines; GEA-1144, super-synchronous motors; GEA-1146, electric furnaces; GEA-1147, reciprocating air compressors; GEA-1150, electric heating equipment; GEA-1152, synchronous motors for pumping; GEA-1157, strip heaters.

Electrical Equipment. Roller-Smith Company, 233 Broadway, New York, N. Y.—Bulletin No. 810—Describes thermocouple ammeters and milliammeters.

Electrical Equipment. Sangamo Electric Company, Springfield, Ill.—Addenda Bulletin 73—Describes switchboard meters for alternating current.

Electrical Equipment. U. S. Electrical Mfg. Company, Los Angeles, Calif.—Catalog 29—"The Story of U. S. Motors," describing construction and features of motors with particular reference to asbestos protection.

Electrical Equipment. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.—Bulletin 165—Completely descriptive of squirrel cage motors; bulletin 159, large vertical motors.

Electrical Equipment. Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.—Publications as follows: L-3746-E, synchronous motor generators; L-20355-A, engine-driven alternating-current synchronous generators; L-20377, geared-turbine generator units.

Equipment. Birmal Chemical Engineers, Dartmouth Road, Smethwick, England.—Well illustrated catalog of aluminum plant equipment.

Extraction. C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland, Ohio.—Bulletin No. 64—Describes solvent extraction of oils and greases and equipment for this purpose.

Filtering. D. R. Sperry & Company, Batavia, Ill.—Bulletin No. 3—Completely descriptive of filter presses.

Fire-fighting. American La France & Foamite Corp., Elmira, N. Y.—New catalog of 176 pages on portable fire-fighting equipment of all kinds.

Furnaces. Hevi Duty Electric Company, Milwaukee, Wis.—Bulletin 629—A picture story of electric furnaces in St. Louis.

Heating. American Blower Corporation, Detroit, Mich.—Bulletin 7818—Complete data on "Venturafin" heaters for floor, wall and ceiling mounting. Also bulletin No. 10401 on "Sirocco" fans for domestic heating.

Heating. Despatch Oven Company, 622-9th St. Southeast, Minneapolis, Minn.—New bulletins, one describing electric oil and salt baths and other japanning and enameling ovens.

Instruments. Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, Ohio.—Bulletin 181—Completely descriptive of Bailey Meter automatic control for combustion.

Instruments. The Bristol Company, Waterbury, Conn.—Catalog 2100—Describes recording psychrometers made by this company; also bulletin on hot blast temperature control.

Instruments. Brown Instrument Company, Philadelphia, Pa.—Catalog 21—Well illustrated 90-page book on the theory, design and use of electric flow-meters.

Instruments. Esterline-Angus Company, Indianapolis, Ind.—Bulletin No. 729—"Studying Costs with Graphic Instruments"; bulletin 829, "Graphic Instruments for the Control of Important Processes."

Instruments. The Foxboro Company, Foxboro, Mass.—Bulletin 115-2—Instruments for the power plant; bulletin 162, steam flow-meters; also new loose leaf sheets on control of temperature, humidity, and level.

Instruments. Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.—New and revised publications as follows: Notebook No. 4, notes on Kelvin bridge; catalog 60, photometers; catalog 86, optical pyrometers; catalog 87, potentiometer pyrometers; catalog 93, the Homo method for production tempering; bulletin 870, potentiometers for temperature control in oil refining.

Lighting Equipment. Crouse-Hinds Co., Syracuse, N. Y.—Bulletin 2136—Describes a small multi-purpose floodlight, type ADA.

Lubrication. Hills-McCanna Company, 2349 Nelson St., Chicago, Ill.—Folder discussing force-feed lubricators.

Material Handling. Stephens-Adamson Mfg. Co., Aurora, Ill.—Bulletin descriptive of the "S-A" box car loader.

Material Handling. Williamsport Wire Rope Co., Williamsport, Pa.—150-page book entitled "Cutting Material Handling Costs," a discussion of material handling from the standpoint of wire-rope equipment. The book is intended as a textbook of tramway and cableway transportation.

Metals and Alloys. American Rolling Mill Co., Middletown, Ohio.—Well illustrated 32-page book dealing with ingot iron in the oil industry.

Metals and Alloys. Babcock & Wilcox Tube Co., 85 Liberty Street, New York, N. Y.—Form 522—completely descriptive of Enduro KA2 seamless tubes and pipe.

Metals and Alloys. Commercial Alloys Corp., 367 Fifth St., San Francisco, Calif.—Folder describes "Cristite," a hard-surfacing metal.

Metals and Alloys. Driver-Harris Company, Harrison, N. J.—Brochure showing, mainly in pictures, the applications of "Nichrome" alloy for heat resistance.

Metals and Alloys. Fansteel Products Company, North Chicago, Ill.—"Rare Metals," a 54-page booklet devoted to the history, properties and uses of tantalum, tungsten and molybdenum.

Metals and Alloys. Gilby Wire Company, Newark, N. J.—1930 Handbook of various kinds of resistance wire made by this company.

Metals and Alloys. International Nickel Co., 67 Wall St., New York, N. Y.—Ten studies in the theory and practice of nickel cast iron.

Power Generation. Buckeye Machine Company, Lima, Ohio.—New catalog describing vertical Diesel engines.

Power Transmission. Marlin-Rockwell Corporation, Jamestown, N. Y.—"Gurney Ball Bearing Manual," condensed handbook arranged for easy reference in the selection of ball bearings made by this company.

Power Transmission. Poole Engineering & Machine Co., Baltimore, Md.—Flexible couplings handbook with data on this company's products.

Power Transmission. Ramsey Chain Company, Albany, N. Y.—Catalog 628—Well illustrated 90 page catalog and data book on silent chain drives.

Power Transmission. Westinghouse Electric & Mfg. Co., Nuttall Works, East Pittsburgh, Pa.—Circular 1856—Nedplates for type SVR and DVR speed reducers.

Pumps. A. R. Wilfley & Sons, Inc., Denver, Colo.—Catalog 7—Completely descriptive of the model C centrifugal sand pump made by this company.

Refractories. Corhart Refractories Co., Louisville, Ky.—Folder describes cast tank blocks.

Refractories. Denver Fire Clay Co., Denver, Colo.—Catalog 141-W—Concerns fire brick, fire-brick shapes, moldable furnace linings and high temperature cement; and bulletin 142-W, on suspended arches and monolithic furnace walls.

Refractories. General Refractories Co., Philadelphia, Pa.—Folder gives record of "Arcofrax" refractories in five kilns.

Refractories. Harbison Walker Refractories Co., Pittsburgh, Pa.—Catalog describes applications of "Firebond," a high temperature cement. Also data on number of bricks for various types of construction.

Safety. Metropolitan Life Insurance Co., New York, N. Y.—Industrial Safety No. 5—Discusses workmen's safety committees from the standpoint of formation, administration, duties and responsibilities.

Safety Equipment. Mine Safety Appliances Co., Pittsburgh, Pa.—Booklet of questions and answers concerning some of the safety equipment made by this company.

Screens. Hendrick Manufacturing Co., Carbondale, Pa.—Complete catalog of perforated metals. Also concerns elevator buckets and steel plate construction.

Screens. Newark Wire Cloth Co., 351 Verona Avenue, Newark, N. J.—Bulletin describing wide range of wire cloth made by this company.

Silica Gel. Silica Gel Corporation, Garrett Bldg., Baltimore, Md.—Publications as follows: "Silica Gel," article by P. L. Poe, describing applications of Silica Gel in a general way; bulletin 3, refining and recovery of petroleum oils; bulletin 6, drying and purifying compressed gases; bulletin 7, an iceless refrigerator; bulletin No. 8, purification of light oils by Silica Gel for motor fuel purposes; bulletin No. 9, freight car refrigeration using Silica Gel; bulletin No. 10, development of Silica Gel refrigeration; bulletin 101, article by E. H. Lewis on "20 Months' Results of Dry Blast Operation."

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York, N. Y.—General catalog GC-5—Describes the more important fuel burning and steam generating equipment made by this company. Also, a folder on a box-header boiler and two reprints, one entitled "Steam Pressures for Industrial Plants Determined by Rational Factors," and the other, "Operating Experience Proves Pulverized Lignite a Satisfactory Fuel."

Steam Generation. Erie City Iron Works, Erie, Pa.—Forms SB11 and SP4, respectively, concerning the three-drum boiler and the "Economic" fire-tube boiler made by this company.

Steam Generation. W. B. Conner Company, 369 Lexington Ave., New York, N. Y.—Booklet entitled "Condensate—Its Dollars and Cents Value and How It Can Be Effectively Conserved," a discussion of condensate with particular reference to steam traps.

Steam Generation. Northern Equipment Co., Erie, Pa.—New catalog describes equipment for boiler feed-water control.

Welding. Fusion Welding Corporation, 103rd St. & Torrence Ave., Chicago, Ill.—Bulletin No. 3—Describes "Weldite" type T welding rod for hard surfacing.

Welding. Lincoln Electric Company, Cleveland, Ohio.—Two folders describe the automatic tractor type of "Electronic Tornado" welder and new "Stable-Arc" welders.

PATENTS ISSUED
Sept. 3 to Sept. 24, 1929

Paper, Pulp and Glass

Device for Controlling the Moisture Content of Pulp. George E. Mayo, Potsdam, N. Y.—1,726,749.

Process and Apparatus for Reducing Pulp or the Like. Lloyd T. Murphy, Franklin, Ohio.—1,726,756.

Beating Engine. Walter Werner, Hoosick Falls, N. Y., assignor to the Noble & Wood Machine Co., Hoosick Falls, N. Y. —1,726,873.

Extractor for Pulping Devices. Walter Werner, Hoosick Falls, N. Y., assignor to the Noble & Wood Machine Co., Hoosick Falls, N. Y.—1,726,874.

Fourdrinier Paper Machine. Alonzo Aldrich and Earl E. Berry, Beloit, Wis., assignors to Beloit Iron Works.—1,726,973.

Waterproof Paper and Process of Producing the Same. Albert L. Clapp, Danvers, Mass., assignor to Bennett, Inc., Boston, Mass.—1,727,003.

Apparatus for Feeding Molten Glass. Karl E. Peiler, West Hartford, Conn., assignor to Hartford Empire Company, Hartford, Conn.—1,727,379.

Grinding Wheel for Paper Pulp. Edward Anderson, Dayton, Ohio, assignor, by mesne assignments, to Simonds Worden White Company.—1,727,389.

Process for Preparing Cereal-Straw Fiber for the Manufacture of Relatively-Thick Fibrous Sheets Therefrom. Edward S. Sheperd, St. Joseph, Mo., assignor to Albert D. Stewart, St. Joseph, Mo.—1,728,258.

Refractory Product and Method of Making the Same. Jesse T. Littleton, Jr., Corning, N. Y., assignor to Corning Glass Works, Corning, N. Y.—1,728,350.

Process for the Manufacture of Refractory Substances. Jean D'Ans, Berlin, Germany, assignor to Deutsche Gasglühlicht-Auer-Gesellschaft m. b. H., Berlin, Germany.—1,728,748.

Process and Apparatus for Producing Sheet Glass. James C. Blair, Toledo, Ohio, assignor to Libbey-Owens Glass Company, Toledo, Ohio.—1,729,147.

Apparatus for Charging Cellulose Digesters, Per Albert Fresk, Robertsfors, Sweden.—1,729,575.

Rubber, Rayon and Synthetic Plastics

Substituted Dithiocarbamates and Method of Making Same. Sidney M. Cadwell, Leonia, N. J., assignor to the Naugatuck Chemical Company, Naugatuck, Conn.—1,726,646-8.

Method of Producing Phenolic Condensation Products. Oscar A. Cherry and Franz Kurath, Chicago, Ill., assignors to Economy Fuse & Manufacturing Company, Chicago, Ill.—1,726,650.

Method of Producing Phenolic Condensation Products. Franz Kurath, Chicago, Ill., assignor to Economy Fuse & Manufacturing Company, Chicago, Ill.—1,726,671.

Art of Vulcanizing Rubber. Clayton Olin North, Tallmadge Township, and Chester William Christensen, Akron, Ohio, assignors to the Rubber Service Laboratories Co., Akron, Ohio.—1,726,713.

Process of Obtaining Aldehyde Condensation Products. Michael Melamid, Berlin-Zehlendorf, Germany.—1,727,076.

Process of Treating Cellulose with Lactic Acid and the Product Thereof. Heinrich Heimann and Alfons Bayerl, Dessau, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,728,206.

Molding Mixture and Method of Making the Same. Victor H. Turkington. Chicago. Ill., assignor to Bakelite Corporation, New York, N. Y.—1,728,378.

Copper-Oxide Ammonia-Cellulose Solution for Spinning Artificial Silk by the Stretch-Spinning Process. August Hartmann, Barmen-Langerfeld, Germany, assignor, by mesne assignments, to American Bemberg Corporation.—1,728,565.

Rubber Composition or Compound for the Manufacture of Paving Blocks, Slabs, and the Like. Edmond Draullette, Paris, France. —1,728,990-1.

Petroleum Refining and Products

Process of Treating Emulsions. Charles Fischer, Jr., Wyoming, and Warren T. Reddish, Cincinnati, Ohio, assignors to Kontol Company, Dallas, Tex.—1,727,164-5.

Preparing Hydrocarbon Products. Frank A Howard, Elizabeth, N. J., assignor to Standard Oil Development Company.—1,727,303.

Distillation Process. James C. Ryder, Passaic, N. J., assignor to Petroleum Derivatives, Inc., New York, N. Y.—1,727,380.

Process of Cracking Oil. Edward W. Isom, Locust Valley, N. Y., and Eugene C. Herthel and Harry L. Pelzer, Chicago, Ill., assignors to Sinclair Refining Company, Chicago, Ill.—1,727,707.

Apparatus for Pressure Distilling Oils. Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,729,035.

Art of Distillation of Petroleum Oils. Richard W. Hanna, Piedmont, Calif., assignor, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,729,215.

Process for Treating Hydrocarbons. Carbon P. Dubbs, Wilmette, Ill., assignor to Universal Oil Products Company.—1,729,307-8.

Vertical Retort for Use in the Distillation of Shale and Like Materials. Robert Henry Crozier, London, England.—1,729,418.

Coal and Organic Processes

Process of Obtaining Lubricating Oils and Phenols from Coal Tar. Anton Weindel, Essen-Ruhr, Germany, assignor to Zeche Mathias Stinnes, Essen-Ruhr, Germany.—1,726,638.

Aëration Apparatus and Method. Herbert A. Gollmar, East Orange, N. J., assignor to the Koppers Company, Pittsburgh, Pa.—1,726,892.

Process for Producing Substituted Guanidines. George Barsky, New York, N. Y., assignor to American Cyanamid Company, New York.—1,727,093.

Production of Benzoic Acid and Like Processes. David Alexander Whyte Fairweather, Ernest George Beckett, and John Thomas, Grangemouth, Scotland, assignors, by mesne assignments, to the Selden Company, Pittsburgh, Pa.—1,727,102.

Process of Manufacturing Cyanides. Hermann Wiederhold, Furstenwalde-on-the-Spree. Germany assignor to the Firm N. V. Nederlandsche Mijnbouw en Handel Maatschappij, Amsterdam, Netherlands.—1,727,261.

Process for the Manufacture of Xylenes. Eduard Tschunkur, Cologne, Mulheim, and Fritz Eichler, Leverkusen-on-the-Rhine, Germany, assignors to General Aniline Works, Inc., New York, N. Y.—1,727,682.

Gas Apparatus. Frank D. Moses, Trenton, N. J.; Thomas Watson executor of said Frank D. Moses.—1,727,892.

Apparatus for Making Oil Gas. Allen E. Dickerman, New York, N. Y., assignor to Gasgo Power Corporation.—1,728,400.

Process for the Continuous Purification of Crude Carbon Disulphide. Eberhard Legeler and Paul Esselmann, Premnitz, Westhavelland, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,728,686.

Method of Carbonizing a Cellulose-Containing Substance Such as Wood, Peat, and the Like. Carl Gustav Schwalbe, Eberswalde, Germany.—1,728,807.

Manufacture of Vegetable Char. Charles E. Coates, Baton Rouge, La., assignor to Oscar L. Barnebey, Columbus, Ohio.—1,729,162.

Coke-Oven-Pusher Control. Albert H. Chalmers, Fairview, Birmingham, Ala.—1,729,327.

Removal of Naphthalene Constituents from Gases. Eugene H. Bird, Pittsburgh, Pa., assignor to the Koppers Company, Pittsburgh, Pa.—1,729,562.

Inorganic Processes

Method of Making Inorganic Oxides. Earl H. McLeod, Rutherford, N. J., assignor to the Ault & Wiborg Company of New York, New York, N. Y.—1,726,851-2.

Production of Ammonia from Its Elements. Carl Müller, Mannheim, and Franz Krägeloh, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,727,174.

Method of Manufacturing Commercial Calcium Arsenate. William C. Piver, Hillside, N. J., assignor to Franklin H. Simpson, East Orange, N. J.—1,727,306.

Method of Purifying Magnesium Sulphate Solutions. Sheldon B. Heath, Midland, Mich., assignor to the Dow Chemical Company, Midland, Mich.—1,727,597.

Process of Obtaining Sodium Tetraborate. Alfred W. Gauger, Tottenville, and Henry Herman Storch, New York, N. Y., assignors to Burnham Chemical Company, Reno, Nev. —1,727,639.

Manufacture of Sulphuric Acid. Henry F. Merriam, West Orange, N. J., assignor to General Chemical Company, New York, N. Y.—1,728,213.

Process of Making a White-Pigment Base. Albert E. Marshall, Baltimore, Md., assignor to Maryland Pigments Corporation, Baltimore, Md.—1,728,296.

Explosive. Guy A. Rupp, Allentown, Pa., assignor to Trojan Powder Company.—1,728,307.

Process of Making Lead Compounds. Chester H. Braselton, Toledo, Ohio.—1,728,388.

Producing Alkali-Earth Metal Oxides. William L. Lawson, Billings, Mont.—1,729,428.

Manufacture of Portland Cement. Povl T. Lindhard, Brooklyn, N. Y., assignor to F. L. Smidth & Co., New York, N. Y.—1,728,495-6.

Method for the Manufacture of Chromic Oxide. Hermann C. Roth, Dormont, Pa.—1,728,510.

Process for the Industrial Manufacture of Artificial Portland Cement. Jean Joseph Hendrickx, Paris, France, assignor to Société Anonyme: Etablissements Poliet & Chausson, Paris, France.—1,728,828.

Production of Rare Metals. John Wesley Marden and Malcolm N. Rich, East Orange, N. J., assignors to Westinghouse Lamp Company.—1,728,940-2.

Phosphorus Production. William H. Waggaman and Henry W. Easterwood, Chicago Heights, Ill., assignors to Victor Chemical Works, Chicago, Ill.—1,728,948.

Apparatus for the Electrolytic Production of Metallic Powders. Matthew Atkinson Adam, London, England.—1,728,989.

Method of Making Hydrochloric Acid. George P. Adamson, Searsport, Me., assignor to General Chemical Company, New York, N. Y.—1,729,431.

Chemical Engineering Processes and Equipment

Recovery of Reaction Products from Gases Treated with Electric Arcs. Otto Eisenhut, Heidelberg, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort on-the-Main, Germany.—1,726,-547.

Filtering Machine. Frederick Olson, Chicago, Ill.—1,726,758.

Protection of Gas Lines. James L. Anderson, Englewood, N. J., assignor to Air Reduction Company, Incorporated, New York, N. Y.—1,726,940.

Process of Coating Aluminum Electrolytically. Carl L. Beal, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,727,331.

Apparatus for Electrolytic and Similar Treatments. Floyd T. Taylor, Matawan, N. J., assignor, by mesne assignments, to Hanson-Van Winkle-Munning Company, Newark, N. J.—1,727,736.

Mill for Homogenizing, Emulsifying, and Kindred Operations. William Eppenbach, College Point, N. Y.—1,728,178.

Condenser. Philander R. Gray, Newark, N. J.; Alanson McD. Gray, administrator of said Philander R. Gray, deceased, assignor to the Gray Processes Corporation, Newark, N. J.—1,728,284.

Mixer. Oliver O. Howard, Yamhill, Ore. —1,728,411.

Rotary Hammer Mill. Walter J. Clement, Utica, N. Y., assignor to the Bossert Corporation, Utica, N. Y.—1,728,392.

Refrigeration. Ernest B. Miller, Baltimore, Md., assignor to the Silica Gel Corporation, Baltimore, Md.—1,729,081-3.

Container for Volatile Liquids. Clayton L. Day, New York, N. Y., assignor to Chicago Bridge & Iron Company.—1,729,156.

Process for Preparing Emulsions of Liquid or Dissolved Substances. Berthold Redlich, Feldkirchen, near Munich, Germany.—1,729,185.

Screw Conveyer. John L. Erisman, Chicago, Ill., assignor to H. W. Caldwell & Son Company, Chicago, Ill.—1,729,211.

Apparatus for Recording Pulsating Pressure. George B. Ireland, Rochester, N. Y., assignor to Taylor Instrument Companies, Rochester, N. Y.—1,729,289-91.

Method of and Mechanism for Drying Materials. William J. Harshaw, Shaker Heights Village, and Charles S. Parke, Cleveland, Ohio, assignors, by mesne assignments, to the Harshaw Chemical Company, Cleveland, Ohio.—1,729,424.

Pulverizer. Grover E. Bear, Allentown, Pa.—1,729,471.

Means for Indicating Quantities Required for the Correct Operation of Continuous Processes. George William Bost, Hillingdon, England, assignor to Republic Flow Meters Company, Chicago, Ill.—1,729,500.

NEWS *of the Industry*

Lacquer Manufacturers Form Trade Group

MANUFACTURERS of about 75 per cent of the lacquer sold have formed a trade group for the purpose of securing the many advantages incident to joint study of the economics, manufacture and merchandising of lacquer products.

It is the purpose of the members of the Institute to take advantage of the encouragement offered by federal institutions such as the Department of Commerce and the Federal Trade Commission in the adoption of a code of business practices that will have to do with the elimination of wasteful methods in manufacturing, selling and shipping the product, standardize containers and their use, study terms, discounts and allowances, promote open and fair competition, and prohibit misrepresentation as to uses and quality of lacquers.

It is contemplated that in the course of time plans will be adopted for the collection and distribution to the trade of accurate statistics having to do with the volume of production and use of lacquer products, and to conduct such campaigns as are desirable to promote the use and service of the material by industrial advertising and other means.

The officers of the Lacquer Institute are Charles H. Reed, the Forbes Varnish Company, chairman; A. W. Steudel, Sherwin-Williams Company, vice-chairman; W. C. Dabney, Jones-Dabney Company, and P. E. Kennedy, Murphy Varnish Company, additional members of the executive committee. H. B. Sweatt, 55 West 42d St., New York, is the secretary and treasurer.

Safety Congress Convenes In Chicago

THE extensive heralding given the eighteenth Annual Safety Congress in Chicago, Sept. 30 to Oct. 4, received ample justification in an enthusiastic and unusually large attendance. Of the numerous groups of the National Safety Council who held sessions during this period, the industrial, metallurgical, and chemical were especially prominent, a feature of the latter being three papers presented on Oct. 3, having direct interest for the chemical engineer. G. H. Miller, of the duPont Company, spoke on "Plant Safety Organization"; Henry N. Marsh, of the Hercules Powder Company, on "Chemistry as an Aid in Accident Prevention," and F. J. O'Connor, of the duPont dye works, on "Safety Factors in Modern Production."

The election of general officers of the Council was held on Sept. 30 and resulted as follows: president, C. E. Pettibone; treasurer, J. I. Banash; and vice-presidents as follows: engineering, E. F. Blank; industrial safety, C. L. Close; membership, D. T. Hellmuth; public relations, Miller McClintock; education, A. W. Whitney; health, C.-E. A. Winslow; territorial councils, George Opp; finance, C. W. Bergquist.

Feldspar Institute Holds General Meeting

A GENERAL meeting of the newly formed Feldspar Grinders' Institute was held Sept. 20-21 at Atlantic City. Most of the business sessions were devoted to acting upon the various committee reports.

Considerable time was given to the work of the package committee, of which C. H. Peddrick, Jr., of the United Feldspar Corporation, is chairman. Mr. Peddrick's committee recommended the use of paper bags for shipping feldspar in the future. After considerable discussion it was voted by the Institute that paper bags would be used as standard after Dec. 1, 1929.

The Feldspar Grinders' Institute was organized last July and includes in its membership practically all the important feldspar interests of the country. Officers are: president, Richard Wainford, Trenton, Flint & Spar Company; vice-president, H. P. Margerum, Consolidated Feldspar Corporation; vice-president, C. H. Peddrick, Jr., United Feldspar Corporation; secretary-treasurer, L. L. Hunt, Bedford Mining Company; commissioner, W. J. Parker; directors, Norman G. Smith, Maine Feldspar Company; H. G. McLear, Green Hill Mining Company.

Texas Gulf Extends Sulphur Operating Rights

The Texas Gulf Sulphur Company has completed negotiations with the Gulf Production Company whereby the sulphur company has acquired all the sulphur operating rights of the Gulf at Long Point, Texas. Drilling is under way and the sulphur mining plant now at Big Creek will be moved at once to Long Point, where mining operations will be started as soon as the plant installation is completed.

Engineers Sail for World Congress at Tokyo

TWO hundred and fifty American engineers and about one hundred Europeans sailed for Tokyo from San Francisco on Oct. 10 aboard the "President Jackson" and "Korea Maru." They are on their way to attend the World Engineering Congress which will be held in November at Tokyo.

President Hoover is honorary chairman of the American Committee of the Congress. Mr. Sperry is chairman, and the executive secretary is Maurice Holland, Director of the Division of Engineering and Industrial Research, National Research Council.

European and American delegates to the coming World Engineering Congress in Tokyo were tendered a farewell dinner on Sept. 26 at the Hotel Astor, New York City, by the members of the American engineering societies and affiliated organizations.

Among the speakers were: Dr. Frank Gill, past president, Institution of Electrical Engineers, London; Senator Luigi Luiggi, honorary member of the American Society of Civil Engineers and member of Institute of Civil Engineers, Rome; Gano Dunn, president of the J. G. White Engineering Corporation, and Elmer Sperry, president of the American Society of Mechanical Engineers.

Princeton Dedicates New Chemical Laboratory

THE new chemical laboratory at Princeton University, which was built at a cost of $1,500,000, was dedicated Sept. 26 with more than a hundred visiting scientists taking part in the occasion. Prof. Hugh Stott Taylor, chairman of the department of chemistry at the university, made the principal address, thanking donors of the building in behalf of the chemistry faculty.

Honorary degrees of Doctor of Science were conferred by President Hibben on Dr. Irving Langmuir, president of the American Chemical Society, and in charge of research for the General Electric Company; Max Bodenstein, professor of physical chemistry at the University of Berlin; Sir James Colquhoun Irvine, chancellor of the University of St. Andrews; Frederick George Donnan, professor of chemistry at University College, London, and Jean Baptiste Perrin, Nobel prize laureate and director of the laboratory of physical chemistry at the University of Paris.

Paint Makers to Maintain Federal Specifications

THE decision of the Bureau of Standards to prepare a separate list of paint and varnish manufacturers who are willing to certify to contract purchasers that their products comply with Federal Specification Board requirements, and to eliminate them from the general directory of manufacturers who have certified their willingness to sell on F. S. B. specifications, is expected to remove the objections to the certification program which have been advanced by the Committee on Certification of the American Paint & Varnish Manufacturers Association. For several months both the certification committee and the Bureau of Standards have circularized paint and varnish manufacturers in an attempt to explain their differences.

As described by a report of the committee sent to the trade the certification plan would extend government specifications to the sale of paint that is made across the counter to the individual consumer buying in small quantities. On this assumption, the committee suggested that manufacturers, who had registered with the Bureau as willing to certify that their products meet the F. S. B. specifications, withdraw their names from the list. The committee took the ground that the certification plan, as interpreted by it, would place emphasis upon government specifications to the detriment of confidence in the manufacturer's name and would ultimately result in the purchase of paint and varnish products on government label and not on trade name.

THE Bureau of Standards objects to the certification committee's version of the certification program and insists that there was no intention to adapt the plan to the sale of paint across the counter. The Bureau points out that there is nothing compulsory upon any manufacturer under its procedure. The Bureau's position on the certification plan, insofar as it relates to the paint industry, was outlined on August 23 by Dr. G. K. Burgess, director of the Bureau of Standards, in a letter to Donald A. Kohr, chairman of the Committee on Certification, as follows:

"The officers of the Bureau feel that if the production majority of paint manufacturers do not want this plan to be carried to and used by the individual small consumer, such as the over-the-counter purchaser, then the Bureau of Standards will make no attempt to popularize the plan in this direction.

"The officers of the Bureau, feel, however, that there are certain corporations and large purchasers of paints which will always buy certain of their paint requirements on specification. While no special attempt will be made to circularize these corporations and large purchasing individuals with the certification plan, it is probably better that they should buy on one set of government specifications than on a number of sets of different specifications.

"The officers of the Bureau of Standards further feel that the certification plan, insofar as it relates to purchases by governmental agencies, is a logical development."

In reply, dated September 21, Mr. Kohr, suggested that the Bureau, remove the names of all paint and varnish manufacturers from its general list of willing-to-certify manufacturers and prepare a separate list of those manufacturers who are willing to supply F. S. B. paint to government agencies only. Circulation of this list to be limited to government offices. Mr Kohr expressed the belief that if this course is followed by the Bureau all paint and varnish manufacturers will desire to be so listed.

The Bureau now is planning to distribute a list of willing-to-certify manufacturers to officers of trade associations, technical societies, and other organizations known to be interested, and also to a relatively small number of firms and individuals who may request the same. The general list of manufacturers, which includes paint and varnish manufacturers, already has been sent to governmental and institutional purchasers, federal, state, county and municipal.

Concentration in German Potash Industry

THE Diet of Anhalt recently approved a contract leasing to the Preussag (Preussische Bergwerke und Huetten Aktiengesellschaft) potash concern rights to mine and operate potash property of the Anhalt concern at Stassfurth-Leopoldshall until 1953. This latest potash fusion further concentrates potash production within the jurisdiction of the few, and leaves but six potash concerns now operating in Germany, namely: Wintershall Aktiengesellschaft; Salzdetfurth Konzern; Burbach Kaliwerke; Preussag; Kali-Chemie Aktiengesellschaft; Deutsche Solvay-Werke.

The leasing of Anhaltische Salzwerke to Preussag was preceded by a bid on the property by Kali-Chemie Aktiengesellschaft. Kali-Chemie's offer was actuated by threatening competition by Preussag in production of potassium carbonate, a commodity on which Kali-Chemie and the I. G. Farbenindustrie have heretofore had a virtual monopoly. This information was forwarded by William T. Dougherty, trade commissioner at Berlin.

CALENDAR

AMERICAN CHEMICAL SOCIETY, 79th meeting, Atlanta, Ga., April 7 to 11, 1930.

AMERICAN ELECTROCHEMICAL SOCIETY, spring meeting, St. Louis, May 29-31, 1930.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, winter meeting, Asheville, N. C., Dec. 2-4.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York, Feb. 19-21, 1930.

Power Show Will Be Held In December

PLANS are well under way for the eighth National Exposition of Power and Mechanical Engineering which will be held at Grand Central Palace, New York City, opening Dec. 2 and continuing throughout the week.

The National Power Show, as the exposition has come to be more briefly known, has become a national institution since its inception in 1922, when the attendance was only 47,589. Last year's attendance had risen to 123,000 and the number of exhibitors had reached a total of 542 in 1928 as against only 105 in the first year of the exposition.

Coincident with the National Power Show, the American Society of Mechanical Engineers will hold its annual meeting in New York City.

Aluminum Sulphate Made In Mexico

A REPORT from A. F. Coleman at the office of the commercial attaché in Mexico states that the Cia., Manufacturera de Productos Quimicos, was recently established in Mexico, D. F., for the manufacture of industrial chemicals. Although not working to capacity (2 metric tons daily) on aluminum sulphate, it, nevertheless, supplies practically the entire domestic requirements. On July 17, 1929, the Mexican government accorded this industry greater protection by increasing the duty to 10 centavos per kilo, or about $48 per ton.

Chemical Salesmen Elect New Officers

AS A result of the recent mail ballot, the Salesmen's Association of the American Chemical Industry has elected the following officers for the ensuing year: President, Victor E. Williams, Monsanto Chemical Works; vice-presidents, Fred A. Koch, Dow Chemical Company; Ira Vanderwater, R. W. Greef & Company, and H. F. Wilmot, A. Klipstein & Company; secretary-treasurer, B. J. Gogarty, American Solvents & Chemical Corporation; members of the executive board, George Bode, Roessler & Hasslacher Chemical Company, and A. L. Benkert, the Noil Color & Chemical Company.

Glidden Acquires Portland Oil Mills

THE entire business properties and assets of the Portland Vegetable Oil Mills Company, Portland, Ore., has been acquired by the Glidden Company. The Portland company, which has facilities for producing 750,000 gal. of refined coconut a month and 12,000 lb. of oil meal a month, has its plant located on deep water with pier and dock facilities for direct importation of raw coconut from the Philippine Islands.

NEWS FROM WASHINGTON

By Paul Wooton
Washington Correspondent of Chem. & Met.

EVEN IF the chemical tariff schedule was of a less controversial character it would receive rough treatment on the Senate floor. As the first commodity schedule to come up, it will have to meet all the opposition which has been seething in the upper house since the tariff was first taken up last January. After the amendments made by the Senate Finance Committee to the House bill are disposed of, the bill will be laid wide open for amendments from any or all of 96 Senators. The prospect is that the chemical schedule will suffer from the trading that will follow if the bill is to be brought to enactment.

Violent attack upon retention of American selling price as a basis for the assessment of duties upon coal-tar products under paragraphs 27 and 28 is expected. The measure of protection accorded by this provision undoubtedly will be opposed as too high. Although retained by both the Senate and House committees, there was strenuous objection from Senator King and other minority members, which indicates that if the ranks of the Democratic-Republican independent coalition are not divided, the American selling price basis will be forced into the discard.

The duties on coal-tar products in paragraphs 27 and 28 are subject to a reduction but not to an increase in duties under the flexible tariff machinery set up by the 1922 act. This provision that the statutory rates on products dutiable on the basis of American selling price could not be increased by presidential proclamation was stricken out by the House committee, and the Senate committee concurred. If, as some people think, coal-tar products have too much protection now, the probability is that this restrictive clause will be restored. Otherwise, under any form of flexible tariff procedure that may be adopted, the ad valorem rates on coal-tar products might be later increased even though they are materially reduced by the bill as finally enacted.

DOMESTIC dye manufacturers regard the action of the Finance Committee in reducing the duties on synthetic indigo and sulphur black to 3c. per pound and 20 per cent ad valorem as the opening wedge for hammering down the rates on other coal-tar products. If the coalition is not successful in its attempt to scrap American selling price it is probable that it will try to reduce the measure of the rates on specific products.

A fight is expected on the derivatives of ethylene and prophylene in paragraph 2. There has been no change in duty, which is 6c. per pound and 30 per cent ad valorem, but the paragraph has been expanded to include many other items such as ethylene glycol, an anti-freeze and partial substitute for glycerin in low-freezing dynamites. There has been a rapid development of solvents, medicinals and other products in this group.

The farm bloc is expected to demand that phosphoric acid shall enter duty free when imported for use in the manufacture of fertilizer. The 1922 act carried a duty of 2c. per pound on this product. The rate on the medicinal grade was increased to 3½c. per pound by the Ways and Means Committee. The use of the medicinal grade in fertilizer manufacture is believed to be limited. None of the non-medicinal grade is imported because the water content makes the freight charge prohibitive. Duty-free importation upon the condition that it shall be used in fertilizer manufacture would create a difficult administrative problem because it would necessitate constant policing. Phosphoric acid does not pay any duty now as a component of mixed fertilizer. It is probable that the farm bloc also will contend for free entry of the ammonium products listed in paragraph 7 when used in fertilizer manufacture.

BELIEF is expressed that the duty on casein will stand at 3½c. per pound, although 8c. is advocated in an amendment proposed by Senator Shortridge. The rate was increased from 2½c. to 3½c. by the Finance Committee after hearing both the dairymen and the paper manufacturers. Casein would lose its principal market if the duty were further increased.

The pyroxylin paragraph may be attacked, as the restricting clause providing that all such articles, whether or not more especially provided for elsewhere, shall be dutiable under this paragraph, has been removed. The duties on such other paragraphs have been increased in many instances. The duty on synthetic camphor may suffer a cut, as the Senate committee restored the 6c. rate after it was reduced to 1c. per pound by the House.

Vegetable oils created very little debate among the majority of the Senate committee, probably because it is not as rabidly "farm relief" as the House committee. The only outstanding change was the reduction in the duty on linseed oil from 4.16c. per pound, the rate carried in the House bill, to 3.7c. per pound. This was the rate proclaimed by the President as a result of an investigation by the Tariff Commission subsequent to the increase voted by the House committee in the statutory rate. The farm bloc is expected to protest vigorously against the denaturing provision, which formerly applied only to olive oil but now includes palm kernel, rapeseed, sunflower and sesame oils. Sesame and palm kernel oil were free of duty under the 1922 act, whether or not denatured.

The sharp increase in the duty carried by the vanadic acid paragraph from 25 per cent in the 1922 act to 40 per cent in the House and Senate bills probably will meet opposition on the Senate floor. Vanadic anhydride has become important as a substitute for platinum as a catalyzer in the manufacture of sulphuric acid.

A CUT is likely in the duty of 18c. per gallon on methanol written into both the House and Senate bills, as, due to the development of synthetic methanol, the proposed duty is more than sufficient to equalize differences in foreign and domestic production costs. The natural product, on the other hand, still has its use as a denaturant in ethyl alcohol under the regulations of the Bureau of Prohibition.

The Senate committee concurred with the House in increasing the rate on butyl acetate from 25 per cent to 7c. per pound. This increase will probably stand, as imports have been heavy and domestic manufacture creates a market for corn.

Salt cake remains on the free list in the Senate committee bill and kraft paper and glass manufacturers will resist any attempt made on the Senate floor to transfer it to the dutiable list.

Although imports are small, insecticide manufacturers are disturbed by the transfer of paris green and calcium arsenate to the free list, but any hope of restoring the duty on these commodities is dim.

The Senate committee cut the duty on calcium carbide from 1c. to ½c. per pound over the objection of the manufacturers, who will attempt to have the existing duty restored when this item comes up on the floor.

There are many other items in the chemical schedule, not of great importance in themselves, that will be the subject of vigorous debate. The complexion of the chemical schedule as it emerges from the Senate will be largely determined by the extent to which the coalition of Democrats and Republican insurgents is split up by the commitments of the senators individually on particular rates.

By a vote of 37 for and 42 against, the Senate rejected the motion of Senator Harrison, Democrat, of Mississippi, that the provision of the present law with amendments to it that were adopted by the House, allowing manufacturers, wholesalers and producers to file formal complaints and supply evidence as to appraisal and classification of dutiable imports, be eliminated from the bill.

Senator Vandenberg, Republican, of Michigan, offered a resolution directing the Commerce Committee of the Senate to inquire into whether it is sound public policy to bring shipping between the United States and the Philippines within the laws governing coastwise shipping.

Trend Toward Improved Conditions In British Industries

Imperial Chemical Industries Develops Fertilizer Production in Australia

From Our London Correspondent

AS FAR as Great Britain is concerned, there is a definite trend toward improved conditions on lines similar to American development. Although apparently real wages are lower and are accompanied by the apparent paradox of increased spending, this is largely due to a diversion of the direction in which expenditure is made. Reduced consumption of spirits and beer and increased instalment buying business are partly responsible and with a more hopeful outlook in the coal, iron and steel trades, the effect of a Labor Government is now regarded with more equanimity.

In the nitrate field, considerable interest was aroused by the report of nitrate deposits in South West Africa referred to by Professor Thomas at the British Association meeting in Cape Town. Although deposits in this district have been examined and reported upon unfavorably on a previous occasion, the nitrate producers are now more inclined to regard them seriously, particularly as recent annual reports and meetings of British nitrate companies show definite signs of a more progressive and enlightened policy. To cite one instance, the Lautaro Company makes public acknowledgment of the advantages of the Guggenheim process and the existing nitrate agreement has made the interdependence of the natural and synthetic industries abundantly clear. Had the Chile nitrate producers taken steps some years ago to enter the synthetic field, the position today would have been even more interesting.

PROGRESS is being made by I.C.I. in Australia. Sir W. Lennon Raws, who represents I.C.I. in Australia, has been actively concerned with Commonwealth Fertilizers and Chemicals, Ltd., which is the name given to the merger of the three most important fertilizer companies in Australia, with a nominal capital of some 35 million dollars. Although at present mainly concerned with superphosphate and mixed fertilizers there is little doubt that there will be an early extension to the synthetic field and that this may be the nucleus of a rationalization of the chemical and fuel industries of Australia under I.C.I.'s auspices.

In the rayon field, the chief item of interest is the agreement on marketing and prices between the Glanzstoff Corporation and the German I.G. The representative of Courtaulds probably will be Dr. E. Lunge, who has so successfully handled in the past the various delicate international negotiations and arrangements for Messrs. Courtaulds. The Tubize Company is reported to be producing a new yarn of subdued luster, under the name of Chardonize, but nothing is known in regard to corresponding developments by British producers.

An event of outstanding importance was the registration last month of the Imperial Smelting Corporation, Ltd., with a capital of about thirty-six million dollars, this being a logical development of the extension of the interests of the National Smelting Company in new directions. The National Smelting Company, with works near Swansea and Bristol, has an annual production of about 30,000 tons of spelter and 100,000 tons of sulphuric acid, the latter being largely produced in the highly efficient war-time "Grillo" contact plants installed under the auspices of K. B. Quinan. Recently, a distillation plant has been installed at the Avonmouth works near Bristol and the production of lithopone and zinc oxide is under development. The board of directors is very influential, representing as it does very important interests in Australia and also the Burma Corporation, and there is little doubt that an interesting and profitable future lies before this very well managed and progressive concern. To what extent any increased production of acid can be absorbed is still a matter for consideration, but the effect of cheap acid in these districts has led to reduced production and closing down of some of the older plants.

REFERENCE was made some time ago to the formation of Chemical and Wood Industries, Ltd., to carry out developments in Jugoslavia and it has just been announced that Dr. A. J. V. Underwood has been appointed general manager in Jugoslavia. Dr. Underwood is one of the rising chemical engineers of this country and it speaks well for the future of the enterprise that he should have sufficient confidence in it to relinquish any part of his practice as a technical and economic consultant.

The annual meeting of the Society of Chemical Industry which was held in Manchester was a great success and very well attended. The new president is Dr. Herbert Levinstein, whose work in the dyestuffs, artificial silk, and chemical world is too well known to need detailed description.

It appears that some twenty societies connected with chemistry, metallurgy and fuel and including the Chemical Society and the Society of Chemical Industry have agreed to co-operate in the building of new headquarters to cost about £350,000. The building will include a central library and joint reading room as well as a social club which will probably be under the direction of the Chemical Industry Club. The new building will be in Westminster, not far from the headquarters of Imperial Chemical Industries.

Particulars are advertised of Metafilters, Ltd., a company with a capital of $400,000, to exploit the invention of J. A. Pickard, who was formerly with the Stream-Line Filter Company. Mr. Pickard's metafilters utilize filter aids in an ingenious manner and appear to be particularly applicable to the bulk filtration of beer, wine, oils and other liquids requiring a high degree of clarification.

A miniature boom has since taken place in the shares of this company which have risen to nearly four times their par value, possibly owing to the operations of a share pool rather than immediate technical prospects.

The announcement of F. W. Berk & Company that they have acquired a site in New Jersey with a view to building a factory is of unusual interest as it is a rare event, in spite of the advantages of thus jumping a tariff wall, for a British concern to venture so far afield outside the Empire. Messrs. Berk have recently been developing refractory linings highly resistant to chemical action and have of course specialized in heavy chemicals for a long time. It would be refreshing to find an extension of this movement and conversely there seems no valid reason why American firms should not reciprocate, taking advantage of low labor and raw material costs as an alternative to overcoming tariff barriers.

New Synthetic Ammonia Plant for Germany

BUILDING has started at Oer-Erkenschwick on the synthetic ammonia plant for the mining companies, Gewerkschaft Ewald, member of Ruhrchemie A. G., and Koenig Ludwig. This new operation calculates to use an American synthetic ammonia process employing 300 atmospheres pressure for a 20-22 per cent ammonia recovery on the first run. The Ewald Koenig Ludwig plant will be one of five new smaller synthetic ammonia layouts built or in building to separate waste coke-oven gas hydrogen for allegedly cheaper product than that produced by the German Dye Trust's Haber-Bosch process.

W. T. Daugherty, trade commissioner at Berlin reports that in organizing finances for this operation, Gewerkschaft Ewald acquired 220 mining shares of Koenig Ludwig and another 60 Koenig Ludwig shares formerly owned by the German dye trust; this transaction put three members of the Ewald directors' board on that of Koenig Ludwig.

Ammonia Companies Merge

The Pacific Ammonia & Chemical Company has been purchased by the National Ammonia Company, which is owned by E. I. du Pont de Nemours & Company. The two concerns will be merged and operated under the name of the National Chemical Company.

French Parliament Proposes Changes In Patent Laws

Chemical Process Patents Will Have Life of Twenty Years

From our Paris Correspondent

THE low sales prices of rayon cut down profits to such an extent that new rayon works who have not already paid off their plants are in a very serious financial position.

On the other hand the 1929 corn harvest is excellent, so good in fact that no foreign cereals need to be imported in France this year. Moreover the 1929 vintage also appears to be exceptionally good both in quality and quantity, and the wine trade, it should be remembered, is one of France's most important assets in her commercial balance. France being both an agricultural and industrial country has, so to speak, no unemployed and slowly, but steadily, is regaining its prewar prosperity, in spite of the heavy handicap caused by the complete destruction and costly reconstruction of all the industrial districts of the rich northern and eastern provinces.

THE National Office of Industrial Property has just published a report giving a general résumé of its activities in 1928. Besides the patent office, the National Office for Industrial Property possesses a public ledger, national trade marks, designs and models.

In 1928 the number of patents granted steadily increased, 21,355 patents being asked and granted as well as 1,659 additional certificates, thus making a total of 23,014. The number of patents granted in France to foreigners has notably increased, 4,000 being granted to Germans, 1,643 to Americans, 1,447 to Britishers, to quote the leading industrial nations only; 1,697 patents and additional certificates have been granted in the chemical branch and its eight subdivisions.

French patents are delivered on demand without any examination whatsoever, either of the patent itself or of its wording. It is in reality merely a recording office, which ought to object to defective patents but in fact never does. The result is that too many patents granted are not clearly described. Foreign chemical patents particularly are too often translated by patent office engineers who are not chemical engineers, a fact which is most prejudicial to the correct wording of the patent. On the other hand as the patent office does not control the patents granted, it sometimes grants several patents for the same product. Recently a patent was granted for the bleaching of dyed textiles by action of zinc and bi-sulphite, the reaction yielding hydrosulphite, (patent No. 652696, April 14, 1928); hydro-sulphite, however, was discovered in France by Schutzenberger fifty years ago.

At present the patent laws are being altered by Parliament. The new laws are now under examination by the Senate and it is not known when they will come into force. One thing is certain however: the defective method of granting patents will not be altered, all modifications proposed having been rejected. The one and only important alteration made in the granting of chemical patents is that in future the patents will protect the process and not the finished product. The process patent will also last five years longer, 20 years instead of 15 years. A special amendment will be introduced in the new trade mark bill to that effect.

The total sum in round figures of all taxes levied by the patent office amounts to 28,300,000 French francs, the fiscal state duties being 22,600,000 French francs, the Patent Office's share is 5,680,000 French francs. This sum not only covers all expenses but leaves an appreciable margin of profit.

THE French lithopone industry was of no great importance before the world war, the home output being about 1,500 tons while the home needs were about 10,000 tons. During the war all French lithopone factories expanded and new works were built. Progressively the home lithopone output reached 10,000 tons. Actually the home needs are 18,000 tons and the difference must be imported, the main importers of lithopone in France being Germany, Holland, Belgium and Great Britain.

Titanium white is now increasingly used as white pigment owing to its remarkable properties which are: low density, extreme fineness, chemical inactivity, innocuousness. It is moreover an excellent color for painting, having a large covering power and not fading in the light.

The Thann Chemical Works at Thann have been specially equipped for making titanium white on a large scale, drawn from ilmenite imported from Travancore, India. Ilmenite is treated by sulphuric acid, the resulting compounds, on being dipped in water, yielding a solution of iron and titanium sulphates which is clarified by a process based on the reciprocal coagulation of two colloïds of contrary signs at the iso-electric point.

By refrigeration of the solution, iron sulphate separates and is eliminated by centrifugalization while the titanium solution, treated by hydrolysis precipitates titanium oxide. The latter is then separated from the mother-waters and washed. The "gel" thus obtained is the raw matter of white titanium pigment; calcinated and ground it is almost chemically pure as it contains at the most only 0.001 per cent of iron.

News in Brief

THE SUGAR BY-PRODUCTS CORPORATION has been formed to manufacture by-products from sugar cane. The company plans to erect a manufacturing plant at New Orleans at a cost of $500,000.

PLANS HAVE BEEN COMPLETED by the Hercules Powder Company for the erection at Wilmington, Del., of a new experimental station, consisting of experimental and chemical research laboratories. Following the erection of the new buildings the experimental staff and research equipment will be moved there from Kenvil, N. J.

DR. GEORGE B. WATERHOUSE, professor of metallurgy in Massachusetts Institute of Technology, will head the Iron Alloys Committee of the Engineering Foundation, it was announced by H. Hobart Porter, chairman of the Foundation.

SUPPLIES OF CITRATE OF LIME in Italy next year from the new crop are estimated at approximately 7,000 metric tons. In addition, the Camera Agrumaria may sell from their stocks quantities amounting to either one-seventh or one-fourth of the new crop, according to market conditions. If the Camera puts on the market 1,750 tons from stocks, this will give a total available supply of approximately 8,750 tons of citrate of lime.

TO DISCUSS FURTHER the plan of organizing a technical society to concern itself exclusively with fundamental textile research a meeting of those interested has been called for Oct. 16 in Providence, R. I. At a previous meeting decided differences of opinion developed as to whether or not the field could be covered by existing societies. There was unanimity of opinion, however, that more should be done to stimulate scientific research. The call was issued by W. E. Emley, Chief of Division of Organic and Fibres Materials, of the Bureau of Standards.

SO SUCCESSFUL was the recent conference in Paris of Department of Commerce representatives in Europe who handle chemical matters that another is planned to bring together those who are specializing in the engineering trades.

AIR REDUCTION COMPANY and U. S. Industrial Alcohol Company have acquired a controlling interest in Pure Carbonic Company of America. The latter company had previously acquired the Compressed Carbonic Company, Inc., Pure Carbonic Company of Illinois and Pure Carbonic Company of California.

Study of Resistant and Unique Metals Active in Germany

New Processes Are Employed in Developing Alloys and Metals

From our Berlin Correspondent

IN A fundamental paper entitled "Living Processes and Technical Methods," Professor Willstätler asserts that mixtures can be of the nature of new chemical combinations and considers it necessary to study other branches of inorganic chemistry, above all the chemistry of alloys from this angle. The assumption is that the chemical and physical properties of a component suffer considerable change due to the presence of other components. In many cases erratic changes in the behavior of metals or carbon have been observed, which are inexplicable from the old standpoint of an element's continued existence in the original state. Manganese steel, with 12-14 per cent Mn and 1.-1.25 per cent C, has a specific magnetism of only 0.10, iron considered as 100. If the carbon is reduced to 0.12, this specific magnetism will rise to 7-10 per cent; but if the manganese content is raised to 17 per cent, carbon remaining the same, the magnetism drops back to 0.10 per cent.

The hitherto unexplained magnetizable alloys of Heusler, e.g. alloys of Cu, Al, Mn, which become magnetic by ageing (continued heating), also show how far experiment has outdistanced theory. Small quantities of copper heighten the resistance of steel; the addition to aluminum of silicon in small proportions makes it more corrosion resistant. Lead becomes a good bearing metal with a low alkali (lithium, sodium) content, and silicon likewise is ennobled by the alkalis. The properties of the alkali in these cases appear to be inhibited. Beryllium has lately been adapted to such uses.

A NEW smelting process for aluminum and its alloys has been invented by the Russian engineer Goldmann, which has certain advantages over the processes of Gillette and James. In the former the aluminum and flux are smelted at different times and not simultaneously as in the American process, which is impractical and slightly hazardous because of possible explosions. The Goldmann process also permits extraction of pure aluminum from scrap.

Investigations on the effect of current and temperature on electrolysis of zinc show that both high voltage and temperature are favorable. Professor Röntgen found that the use of pure electrolytes, considerably warmed, gave extraordinary yields, especially in the presence of colloids.

The Eisenschwamm G.m.b.H., founded jointly by the Vereinigten Stahlwerke and Fried. Krupp A. G. to produce steels under patents of the Norsk Staal, will go into production at the beginning of 1930. The experimental plant will produce at the rate of 40,000 tons a year, and the results will determine whether or not the option on other patents of Norsk Staal will be exercised.

The new process for iron carbonyl of the I.G. is based on the use of iron ore and carbon monoxide at temperatures up to 500 deg. C. and about 200 atm. pressure. It was found best to begin at 50 atm. and rise slowly to 200; if the temperature exceeds 550 deg., cooling and lowered pressure must be resorted to. The rate of gaseous flow, about 500 lit. per hour, must be such that the effluent gas does not contain more than 6 per cent by volume of Fe $(CO)_5$ vapor.

It differs from nickel carbonyl in its light sensitivity above 60 deg. C. Its use as an anti-knock injection is well known, and it is of further importance for making pure iron through heating in the absence of air. Likewise it can be heated into finely divided iron oxide in the presence of air, and into hydrocarbons in the presence of hydrogen. Its main application, however, is in catalysts for ammonia synthesis and other chemical reactions.

THE German coking industry is making lively progress. Thus the Vereinigten Stahlwerke A.G. in Düsseldorf have placed in service a number of batteries that were idle, since the demands of the market and their own smelting plants is now considerable. The company now depends on 27 plants with 65 batteries of a total of 3,725 ovens; in all it has built 894 ovens with an annual output of 5 million tons since its formation.

Synthetic gasoline from water has been studied by H. Tropsch and H. Koch. Synthesized at atmospheric pressure with catalysts, it contains more than 50 per cent of olefines. Saturated hydrocarbons present are paraffines exclusively, while no naphthenes are present.

The technical application of trichlorethylene "Tri" as solvent was discussed by G. Wolf at the V.D.R. Apparatus coming in contact with "Tri" should be galvanized or tinned, because iron degreased by it is especially prone to rust. Since above 125 deg. C. "Tri" tends to release HCl it is treated with calcined soda to dry and clean it of HCl. Fumes have proven harmless on the whole except in cases of very flagrant negligence in handling.

The firm of Hartmann & Braun, Frankfort, is introducing two industrial pyrometers called Pyropto and Pyrradio. The former is a portable instrument for 800-3500 deg. C., and the latter is adapted for attachment at the point of use, for 800-2000. At a meeting of illuminating technologists at Vienna, L. Bloch introduced a turbidity meter and optical glass tester.

A new drying method developed by Fried, Haas, Lennep, is described in the *Chemiker-Zeitung*. The solution is shot through a small nozzle into a drying tower, while the stream is met by a shot of warm air. The latter is so controlled that the prospective products, salts or colloids, are produced within the automatic enclosed vessel in a few seconds in the form of a powder with any desired water content.

The centenary of the birth of August Kékulé, the great chemist and formulater of the benzene ring, on which so much organic chemical progress has been based, was recently commemorated at special session of the Deutsche Chemische Gesellschaft at Bonn.

Nitrogen Patents Contested In Germany

A CONTEST over fixed nitrogen patents has arisen in Germany which is of interest to nitrogen enterprises endeavoring to utilize waste coke-oven gas and to find a cheaper source of hydrogen. William T. Daugherty, American Trade Commissioner at Berlin, reports that Gewerkschaft Victor has lost in the first instance the suit brought against it by Concordia Bergbau Gesellschaft for alleged violation of patent protection on the coke-oven gas separation by liquefaction and subsequent fractional distillation. The Gewerkschaft Victor concern operates a Claude ammonia synthesis after a Bronn-Concordia-Linds coke-oven gas separation. Gewerkschaft has appealed the case, and continued its operations.

The Concordia process involves condensation and cooling the coke-oven gas mixture, containing benzol and water, liquid acetylene, liquid methane, liquid carbon monoxide and nitrogen, and an unliquified mixture of 92 volume per cent hydrogen and 8 volume per cent nitrogen. The liquid byproduct components are vaporized and mixed and led back into the plant for their heat value.

This separation of the illuminating components on the one hand and the hydrogen-nitrogen mixture on the other, even if not in the proportion of 3:1 for the ammonia synthesis, is the point on which the suit is placed. It is alleged that Gewerkschaft recovers 17-18 volume per cent of nitrogen in the separation. The declaration of Gewerkschaft that its gas mixture is contaminated with carbon monoxide was apparently overruled, Concordia contending that this contamination would have to be removed in order for the catalyst to function properly.

Gewerkschaft Victor is controlled on a 50-50 basis by the Wintershall Aktiengesellschaft and the Kloeckner concerns.

MEN *in Chemical Engineering*

HERBERT H. DOW is to be the recipient of the Perkin Medal for 1930, an award made as a result of his researches in bromine, the alkalis and magnesiums salts. The presentation will be made at the Chemists Club, New York, on Jan. 10, with J. T. Pardee, E. O. Barstow and William H. Nichols as speakers. Dr. Dow was one of the early leaders of the American chemical industry, to which the present Dow Chemical Company, under his active guidance, is ample testimony and tribute.

HORACE BOWKER, who has been vice-president of the American Agricultural Chemical Company since 1920, was elected president of that company to succeed George B. Burton. Mr. Bowker, a Harvard graduate, has devoted his entire career to the fertilizer industry and came to his present company as secretary in 1908.

ROBERT S. BRADLEY, chairman of the board, and GEORGE B. BURTON, president, of the American Agricultural Chemical Company, have both declined to accept re-election in view of their long periods of service. They will continue, however, as members of the board.

GEORGE S. DAVISON has resigned as vice-president of the Gulf Oil Corporation and as president of the Gulf Refining Company to concentrate his energies on the Davison Coke & Iron Company, Neville Island, Pa., which he founded this year. His connection with the Gulf company had already lasted 25 years.

F. A. LEOVY has been elected president of the Gulf Refining Company of Louisiana and eleven affiliated companies, with jurisdiction over production and pipe line operations.

G. R. NUTTY has been elected president of the Gulf Refining Company and will have charge of refining and marketing operations.

H. G. DEMING is resuming his professorship at the University of Nebraska after spending a year with Arthur D. Little, Inc., Cambridge, Mass.

R. C. BECKSTROM, dean of the school of petroleum engineering at the University of Tulsa, left for Russia on October 15 to make a lecture tour of several schools there and to engage in consulting work.

J. JORGENSEN is now engaged in chemical research with the Western Precipitation Company, of Los Angeles, Calif.

TED ROSEBAUGH has resigned from the engineering staff of the Pacific Gas & Electric Company in San Francisco, Calif., to take up work as an engineer with the Shell Development Company, of California.

JOHN W. MCCOY has been appointed general manager of the explosives department of the duPont Company, and is succeeded as assistant manager by E. B. Yancey. He has been with the company since 1902, when he completed his studies to join the Repauno plant. He has been engaged in work on explosives ever since, and was transferred to Wilmington in 1926.

ELMER K. BOLTON, former chemical director of the dyestuffs department of the duPont company, has become assistant director of its central chemical organization. He is succeeded by Harold W. Elley. Dr. Bolton has been with the company since 1915 and was in his former position since 1921.

B. G. SLAUGHTER was recently elected president of the Tubize Artificial Silk Company of America, on the resignation of Walter L. Coursen, who remains on the board of directors. For many years Mr. Slaughter was connected with the mining and smelting industry as vice-president of the Canadian Copper Company, which later became the International Nickel Company of Canada, and as vice-president of Tennessee Copper Company.

B. G. SLAUGHTER

During the War he became general manager for the American Potash Company's plants. Later he was vice-president and general manager of Meigs, Bassett & Slaughter, Inc., and, as such, had responsible charge of the design and construction of the Tubize plant, where, since 1923, he has been assistant to Mr. Coursen. Mr. Slaughter will continue his residence at Hopewell, Va., with personal direction of the plants of the company.

R. R. DEAN, who for the past 10 years has been associated with the Western Electric Company's Hawthorne plant at Chicago, has joined the metallurgical division of the U. S. Bureau of Mines, Washington, as its chief engineer. He will have general supervision of the research program conducted by the Bureau at its various experiment stations.

Mr. Dean was born in 1897 and pursued his scientific studies successively at the University of Missouri, Chicago, and Harvard. After a subsequent teaching career he was engaged by the Anaconda Copper Mining Company and the American Zinc, Lead and Smelting Company, before ultimately joining the Western Electric Company.

CARBON PETROLEUM DUBBS, inventor of the Dubbs oil cracking process, received the award of the John Scott Medal by the City of Philadelphia "for the discovery and development of process for economically producing gasoline on a large scale." Mr. Dubbs is vice-president of the Universal Oil Products Company, the owner of the process cited in the award.

L. G. ROBINSON has been named general manager of the dyestuffs department of the duPont Company to succeed W. F. Harrington, who was elected to the executive committee. Mr. Robinson has been with the company since 1905, having come there directly from Swarthmore College. He spent a number of years in the Eastern laboratory, and during the War was chemical superintendent at Old Hickory, Tenn.

T. E. ALCORN has resigned as assistant technical director of the Celluloid Corporation, Newark, N. J., to join the McGraw-Hill Publishing Company. He had been with the Celluloid company for nine years and with supervision over pyroxylin manufacture had become an authority on nitration. His duties will be taken up by B. Andersen.

HUGH K. MOORE, past president of the American Institute of Chemical Engineers and active figure in pulp and paper technology, has announced his candidacy for Governor of New Hampshire. Dr. Moore is chief chemist and chemical engineer for the Brown Corporation and is resident at Berlin, N. H.

W. R. HUCKS is now in charge of research and development work of the Pacific Goodrich Rubber Company, Los Angeles, Calif.

WAYNE H. CARTER has resigned as chief chemist of the Sharples Solvents Corporation, Charleston, W. Va., to join the technical department of the Carrier Engineering Corporation, Newark, N. J.

EDWARD BROWNING SANIGAR, of Sheffield, England, was selected to receive the Weston Fellowship of the American Electrochemical Society. A student of several European universities, Dr. Sanigar was especially interested in the electrodeposition of silver and, more latterly, chromium. At present he is doing research at Columbia University.

BRADLEY STOUGHTON has been named to receive the Grasselli Medal for 1929, the award to take place on Nov. 8. Dr. Stoughton, who is professor of metallurgy at Lehigh University, will receive the award in recognition of his research on light structural alloys, although much of his work in the past has concerned iron and steel.

JAMES A. RAFFERTY, who was elected president of the Carbide & Carbon Chemicals Corporation on Sept. 10, has been associated with the Union Carbide & Carbon Corporation since 1917, when he entered the employ

Photo by Blank & Stoller
JAMES A. RAFFERTY

of the Linde Air Products Company as assistant general superintendent of plants. Prior to that time, he was employed by the Peoples Gas Light & Coke Company, of Chicago. In 1924, he was elected vice-president of the Carbide & Carbon Chemicals Corporation.

In addition to his new responsibilities, Mr. Rafferty is a vice-president of the Linde Air Products Company, the Prest-O-Lite Company, Inc., and Union Carbide & Carbon Research Laboratories, Inc., and president of the Clendenin Gasoline Company. He also is a director and secretary of the Niacet Chemicals Corporation.

Mr. Rafferty was born in Chicago. He is a graduate of Lewis Institute of Technology, where he received the degree of M.E. in 1908. He is a member of several scientific societies and makes his home in Rye, N. Y.

R. L. COPSON, who has been engaged in industrial research work on the staff of the Massachusetts Institute of Technology, has been named as instructor in chemical engineering at Yale University.

T. C. LLOYD has been appointed instructor in chemical engineering at Yale while continuing his candidacy for the doctorate in chemical engineering at Columbia University. Mr. Lloyd was formerly with the Central Alloy Steel Company and the Pittsburgh Crucible Company.

M. C. MOLSTAD has resigned his position as instructor at Yale University, to accept a position with the duPont Ammonia Corporation, and is now stationed at Charleston, W. Va.

RALPH J. REED has resigned as chief engineer of the Union Oil Company of California. In his long service with this company Mr. Reed has had charge of design and erection for extensive reservoirs, pipe lines, refineries and manufacturing plants.

EVALD ANDERSON, of the Western Precipitation Company, Los Angeles, Calif., has sailed for Europe and will spend several months in England, Germany and Sweden.

OBITUARY

HENRY J. KREBS, chairman of the board of the Krebs Pigment & Chemical Company, Newport, Del., died on Oct. 7 at Wilmington at the age of 82. Mr. Krebs was a native of Denmark but came to this country in 1879 and soon was associated in the Delaware Beet Sugar Company with A. D. Warner. In an engineering capacity he later joined the Pusey & Jones Company, for whom he built the first ice plant in Delaware. In 1886 he combined with W. G. Pennypacker and A. D. Warner to form the Delaware Chemical Company for the manufacture of anhydrous ammonia. This company, through mergers, later became the National Aniline Company. The Krebs Pigment & Chemical Company was begun by him in 1901 and he remained president of it until a short time ago, when he became chairman.

KONSUL W. C. KUMMER, acting president of the American Bemberg and Glanzstoff plants at Elizabethton, Tenn., was found dead at his home on the morning of Oct. 1 with his wrists slashed. He had been suffering from several ailments, and a note left for Dr. Fritz Bleuthgen, head of the company's interests here and abroad indicated that his activities for the rayon industry had drained him severely. Dr. Kummer came to this country about two months ago to take the place of Dr. Arthur Mothwurf, and succeeded, by his open methods toward employees, in quieting a threatened disorder.

JOHN S. WOOLFORD, president of the G. Woolford Wood Tank Company, Philadelphia, Pa., since 1911, died at his home in Newfield, N. J., on September 7 at the age of 86.

JOSEPH E. HUSTON, secretary-treasurer and one of the founders of the Connersville Blower Company, died at his home in Connersville, Ind., on September 23 at the age of 67.

THOMAS J. DEE, vice-president and treasurer of the Davison Chemical Company, Baltimore, Md., died on August 29 in New York.

GEORGE F. WHITE, professor of chemical engineering at Clarkson College of Technology, Potsdam, N. Y., died instantly from a fall down a flight of stairs on Sept. 18. For the past five years Dr. White had been director of the science department for Bauer & Black, Chicago, Ill.

WILLIAM HENRY PERKIN, professor of chemistry at Oxford University since 1912, died on September 17 at Oxford at the age of 69. Professor Perkin was the son of the famous Sir William Henry Perkin, who played such a vital part in founding the coal-tar dye industry. Following this tradition he was sent to study in England and Germany, whence, after working with Baeyer, he returned to teach in British universities. In addition to his chair at Oxford, he held the post of director of research for the British Dyestuff Corporation and was appointed to its board in 1924.

INDUSTRIAL NOTES

GENERAL INSTRUMENTS COMPANY has been formed to direct and operate the James P. Marsh Company, Chicago; American Paulin System, Inc., Los Angeles, and the Tiffany Mfg. Company, Newark; officers are Vincent Bendix, chairman; O. W. Thompson, president, and W. J. Buettner, secretary-treasurer. The products are to be a complete line of technical and industrial instruments.

THE J. P. DEVINE MANUFACTURING COMPANY has transferred its plant and manufacturing facilities from Buffalo, N. Y., to Mt. Vernon, Ohio.

GENERAL ELECTRIC SUPPLY CORPORATION is an amalgamation of the fourteen distributing companies owned by the General Electric Company, and was formed to offer improved distribution throughout the country.

GILBY WIRE COMPANY, Newark, N. J., has appointed Arlington Bensel to take charge of the sales of its products.

JOHNSON-CARLSON TANK COMPANY, Chicago, has appointed Weaver Bros. Company, Adrian, Mich., as exclusive representative for the metal pickling line.

DODGE MANUFACTURING CORPORATION, Mishawaka, Ind., has promoted E. S. Grant to the post of general sales manager.

LOUISVILLE DRYING MACHINERY COMPANY has opened an export office at 15 Park Row, New York.

CHAIN BELT COMPANY, Milwaukee, has transferred its Houston, Texas, office to 1310 Second National Bank Building.

AMERICAN I. G. CHEMICAL CORPORATION is now located at 521 Fifth Avenue, New York.

SUPERIOR STEEL CORPORATION, Pittsburgh, has been named as sales agent for the Rustless Iron Corporation of America.

HILL CLUTCH MACHINE & FOUNDRY COMPANY has opened a New York office at 30 Church St., in charge of A. L. Whiteside.

MERCO NORDSTROM VALVE COMPANY has opened a new office at the Healey Building, Atlanta, Ga.

E. LEITZ, INC., New York, has placed offices at 122 South Michigan Avenue, Chicago, and 927 Investment Building, Washington.

ELMORE CENTRIFUGAL PRODUCTS CORPORATION has been formed at St. Louis to develop the business of G. H. Elmore, Philadelphia, in conjunction with the Scullin Steel Company. The officers are: John A. Love, chairman of board; Harry Scullin, chairman of executive committee; G. H. Elmore, president; R. A. Bagnell, A. F. Howe, Horatio Potter, vice-presidents; and A. L. Sautter, secretary-treasurer.

COMBUSTION ENGINEERING CORPORATION has discontinued its representation by Schumaker-Santry Company, Boston, and has established a Boston office at 100 Arlington Street.

STACEY ENGINEERING COMPANY has been formed as a holding company for the following concerns: Stacey Brothers Gas Construction Company, Cincinnati; Connersville Blower Company, Connersville, Ind., Wilbraham-Green Blower Company, Pottstown, Pa. The new company is led by Beman G. Dawes, C. A. Thompson, F. S. Heath, and heads of the companies involved.

PENNSYLVANIA PUMP & COMPRESSOR COMPANY, Easton, Pa., has appointed J. W. Eshelman representative at American Traders Bank Building, Birmingham, Ala.

MONSANTO CHEMICAL WORKS has moved its Eastern district office to 10 East 40th Street, New York.

WAGNER ELECTRIC CORPORATION, St. Louis, has appointed J. B. Holston as manager of the St. Louis sales office and A. B. Emrick as manager at Dallas, Texas.

ECONOMIC INFLUENCES
on production and consumption of CHEMICALS

Distribution of Chemicals Maintained On Active Scale

Larger Shipments Anticipated in Final Quarter of Year

THERE IS so far no evidence, either in the statistical barometers or trade sentiment, of any general or unnatural slump in business. What is happening is apparently only a gradual readjustment of the automobile-building-steel group of industries back to a more normal level of activity following a long period of unseasonable or excessive expansion. This is the view set forth in the current issue of *The Business Week*.

Even this applies chiefly to the automobiles, tires, oil, and accessories group, which have been going a little too fast for the consumer and are normally in their slack season, anyway, at this time of the year. The slump in construction also is mainly in residential building. Steel business is being sustained on about as high a level as last year by steady and widely varied demand from other lines of construction and manufacturing, which continue normally active. Railroad movement of commodities is high and general trade remains good.

A probable increase in the next three months of about 1.3 per cent in the level of agricultural and industrial activity in midwest territory, as compared with the closing quarter of 1928, was predicted at the fall meeting of the Midwest Shippers' Advisory Board. The territory covered by the board's activities, and included in this forecast, comprises Illinois, Iowa and Wisconsin, western Indiana and northern Michigan.

ACCORDING to the reports, an increased level of activity in the coming three months, as compared with the corresponding months a year ago, will be shown in thirteen lines. These increases range from 20 per cent in the case of hay, straw and alfalfa to slightly more than 1 per cent in the movement of iron and steel.

In addition to these two increases, there is anticipated an increase of 12 per cent in the movement of canned food products, increases of 10 per cent for machinery and boilers and for petroleum and its products, 6 per cent for coal and coke and for brick and clay products, and an increase of 5 per cent for chemicals and explosives, agricultural implements, and flour, meal and other mill products. Movement of cement is expected to show an increase of slightly over 4 per cent; of paper, paperboard and prepared roofing an increase of 3 per cent and of lumber and forest products an increase of almost 3 per cent, while little change was forecast for ore and concentrates, salt, sugar, syrup and molasses, and lime and plaster.

The fact that future shipments of chemicals are estimated at a higher rate of increase than is expected for the all-commodity list bears out reports that recent declines in industrial activities have been felt mainly in lines which are not important consumers of chemicals.

The increase in sulphuric acid production in the present year naturally has created a wider market for sulphur. The domestic output of sulphur for the first half of 1929 was reported at 1,192,567 tons as compared with 926,910 tons for the corresponding period of 1928. Distribution of sulphur has been aided by a more active call from foreign countries. This may be seen from the fact that exports for the first eight months of the year amounted to 528,029 tons in 1929 and 445,725 tons in 1928.

Productive activities in some of the chemical and chemical-consuming industries, according to latest available statistics, will be found in the accompanying table:

Production

	August, 1928	August, 1929
Acetate of lime, 1,000 lb	9,486	11,025
Methanol, crude, gal	535,803	656,414
Methanol, ref., gal	436,811	454,160
Turpentine, wood, bbl	6,274	6,721
Rosin, wood, bbl	37,623	38,315
Pine oil, gal	225,668	229,388
Arsenic, crude, ton	2,086	887
Arsenic, ref., ton	803	857
Byproduct coke, 1,000 tons	3,995	4,643
Automobiles, cars, no	400,124	443,714
trucks, no	60,705	54,918
Plate glass, 1,000 sq.ft	12,159	14,716
Glass containers, 1,000 gross	2,686	2,715
Explosives, 1,000 lb	35,092	40,584

Consumption

	August, 1928	August, 1929
Cotton, bales	526,340	558,113
Silk, bales	50,821	59,704
Wool, 1,000 lb	45,103	52,644
Cottonseed oil, bbl	306,000	319,000
Fertilisers, in South, ton	62,823	45,517

September production of motor vehicles totaled 417,000, according to estimate of National Automobile Chamber of Commerce. This compares with 513,843 in August and 436,507 in September, 1928.

Estimated nine months production is 4,828,720 units, compared with 3,672,869 in the first nine months of last year and 4,601,130 for the full year 1928.

Compilations of the National Fertilizer Association show that total production of fertilizer for the year ended July 31 was 3.5 per cent less than for the preceding year, the Northern area showing a decrease of 5.5 per cent and the Southern area 1.7 per cent.

Shipments to consumers, dealers, etc., for the year ended July 31 were 5.9 per cent less than for the preceding year, the Northern area showing a decrease of 8.2 per cent and the Southern area of 3.8 per cent. Shipments to mixers were 0.2 per cent larger than for the preceding year, the Northern area showing a decrease of 3 per cent but the Southern area an increase of 2.8 per cent. Shipments to other manufacturers were 0.7 per cent less than for the preceding year, the Northern area showing an increase of 7.1 per cent but the Southern area a decrease of 9.2 per cent. This change may have been due to a shift in ownership of plants.

ACCORDING to the weighted index number of the Federal Reserve Board industrial output during August, after adjustments for seasonal conditions, showed no change from the preceding month but was higher than a year ago. The output of manufactures likewise showed no change from the previous month and a gain over the corresponding period of 1928. As compared with the preceding month declines, however, were registered in production of iron and steel and non-ferrous metals, but these were offset by gains in the remaining important industrial groups.

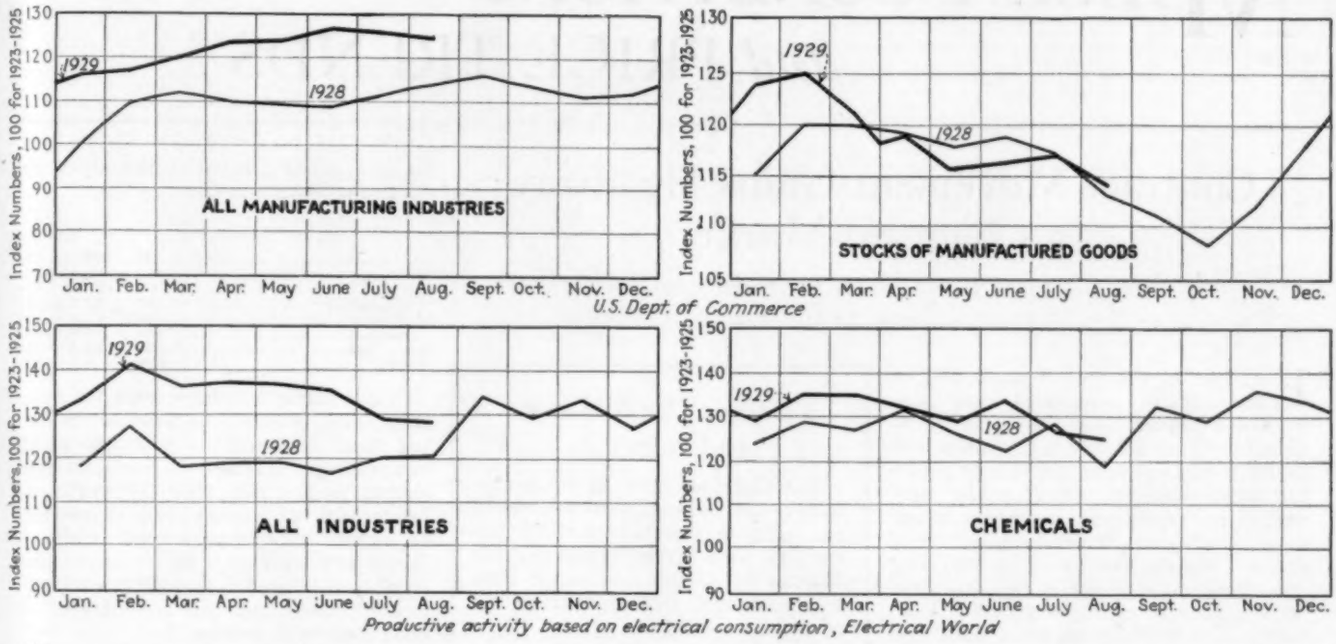
The general index of commodity stocks showed a gain for the end of August as compared with both the preceding month and the corresponding period of last year. The increase over both periods was due to larger holdings of raw materials. Smaller stocks of manufactured goods were reported than in either period.

The general index of unfilled orders showed a further decline from the previous month but was still slightly higher than in August, 1928. Forward business for all groups for which data are available was lower than in July, while as compared with last year all groups showed higher unfilled orders except lumber, which showed no change.

Foreign trade in chemicals and related products likewise has been of a progressive nature so far this year. Latest official figures cover the month of August and show that exportations for the first eight months of the year carried a valuation of $102,101,773 as compared with $92,239,461 for the corresponding period of last year. This represents a gain of more than 10 per cent for the period.

Import trade while larger than it was a year ago shows only a small rate of increase, the valuations for the eight month period, being $99,622,579 and $99,462,000 for 1929 and 1928 respectively.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



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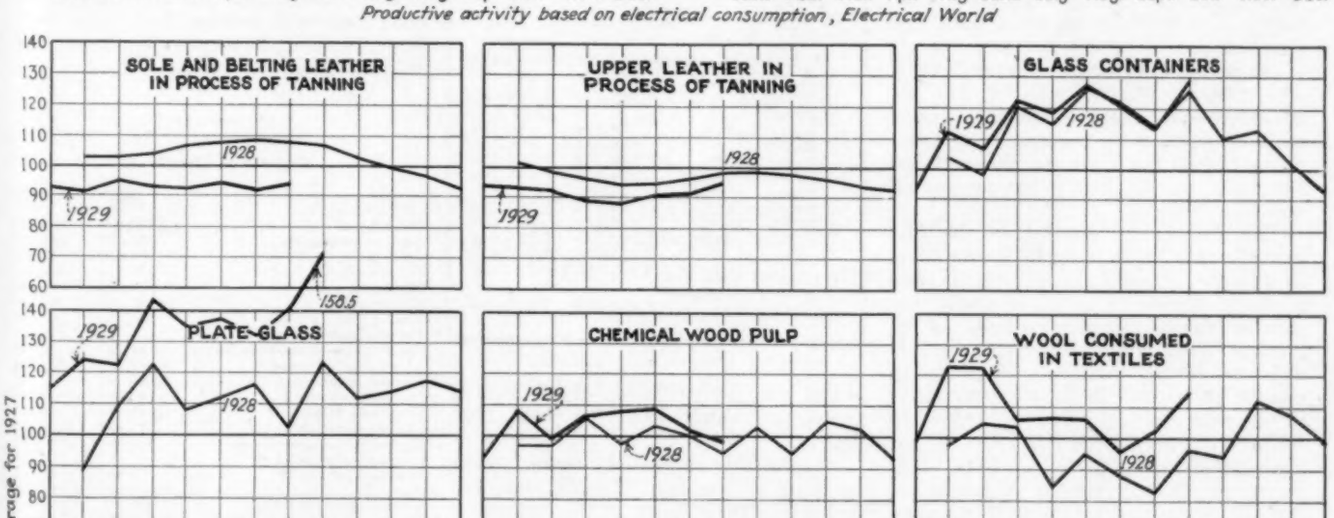


Productive activity based on electrical consumption, Electrical World

MARKET CONDITIONS *and* PRICE TRENDS

Contract Movement Gains Headway In Chemical Market

Producers of Bichromates Extend Prices to Include 1930 Deliveries

EARLY in the month producers of bichromates announced that contracts for delivery over next year would be accepted on a basis of 7c. per pound for bichromate of soda and 9c. per pound for bichromate of potash. The new quotations represent no change from those which were in effect on 1929 contracts. New prices have not yet been announced for other basic chemicals but market reports credit a growing contract business in caustic soda, soda ash, and chlorine at about the same levels as were quoted for the present year. The contract season, however, has not advanced sufficiently to admit of comparison between the volume of contract commitments for 1930 and those placed for 1929, as the heavy buying period still lies ahead.

The market in general in the last month has been featured by a steadiness in prices. Among the exceptions was a sharp decline in sales schedules for caustic potash. Imported caustic is becoming increasingly important and is dominating the market. Imports of caustic potash for the first eight months of this year reached a total of 10,382,515 lb., as compared with 7,641,409 lb. for the corresponding period of 1928. The value of caustic potash imported in August, according to consular invoices, was on an average of slightly more than 6.05c. per lb. Copper sulphate also was lowered in price a few days ago, but this was entirely due to local conditions as represented by a reduction in producing costs.

IN CONNECTION with the world increase in production of nitrogenous materials it is of interest to note a report from Germany which states that the German Ammonia Sales Cartel announced sales of 400,000 metric tons of byproduct ammonium sulphate in 1928, equivalent to approximately 80,000 tons of primary nitrogen. This cartel is a member of the German Nitrogen Syndicate, of Berlin, dominated by the German dye trust, now producing about 700,000 tons of primary nitrogen annually. The nitrogen cartel's membership also includes the calcium cyanamide producers.

Production by the byproduct ammonia producers increased 13 per cent in 1928 over the preceding year. The increase was chiefly from the new synthetic plants, which contributed 43,000 tons of ammonium sulphate to the total 1928 figure.

Despite this increased output, stocks on hand at the end of 1928 were but two-thirds their level at the beginning of the year. Export sales by the byproduct ammonium sulphate cartel were 40 per cent higher than 1927.

The production of the new Montansaltpeter DAVV, by Gasverarbeitung Aktiengesellschaft, an ammonium sulphate-nitrate comparable to the dye trust's Leunasaltpeter, amounted to about 20,000 tons by the end of December, 1928. This product has 26 per cent nitrogen content.

MANUFACTURERS of paints, varnishes, printing inks, linoleum, and soap have been interested in the position of related materials more than in chemicals proper. This interest centered chiefly in vegetable oils. Low prices in primary markets and fears of an increase in import duties brought about a sharp increase in importations and large surplus stocks caused selling pressure in domestic markets, especially when the probability of tariff imposts was lessened. The extent to which imports increased may be seen by reference to the import figures for the eight months ended August, which offer the following comparisons:

	1928 lb.	1929 lb.
Coconut	158,979,103	273,712,175
Sulphur	27,486,955	35,438,221
Palm	104,554,792	196,566,874
Palm-kernel	39,297,237	54,336,174
Sesame	3,938,080	17,579,427
Linseed	161,853	6,668,332
Soya bean	9,034,427	13,314,790
Perilla	1,179,994	5,544,319

Naval stores also have attracted more than usual attention because of the rising tenor of prices. The storm which caused heavy damage at Southern producing points also retarded work and brought about a sharp drop in receipts of spirits of turpentine and rosin at primary markets. It is estimated that receipts at Savannah and Brunswick will fall off about one-third in October as compared with October last year. Still larger declines in receipts are looked for at Jacksonville and Pensacola.

Larger Use of Lime In Chemicals

Sales of lime used in the manufacture of chemicals increased 10 per cent in quantity in 1928 according to a report issued by the Bureau of Mines. Sales of lime to the various industries were reported as follows:

Use	1927 Short tons	1928 Short tons
Agricultural	322,893	333,910
Building	2,148,840	1,986,465
Chemical		
Glass works	78,994	76,161
Metallurgy	406,063	504,248
Paper mills	429,606	429,334
Refractory lime	374,415	448,761
Sugar refineries	16,086	22,678
Tanneries	63,666	64,464
Other uses	574,369	592,391
Total chemical	1,943,199	2,138,037
	4,414,932	4,458,412
Hydrated lime (included in above totals)	1,596,906	1,612,818

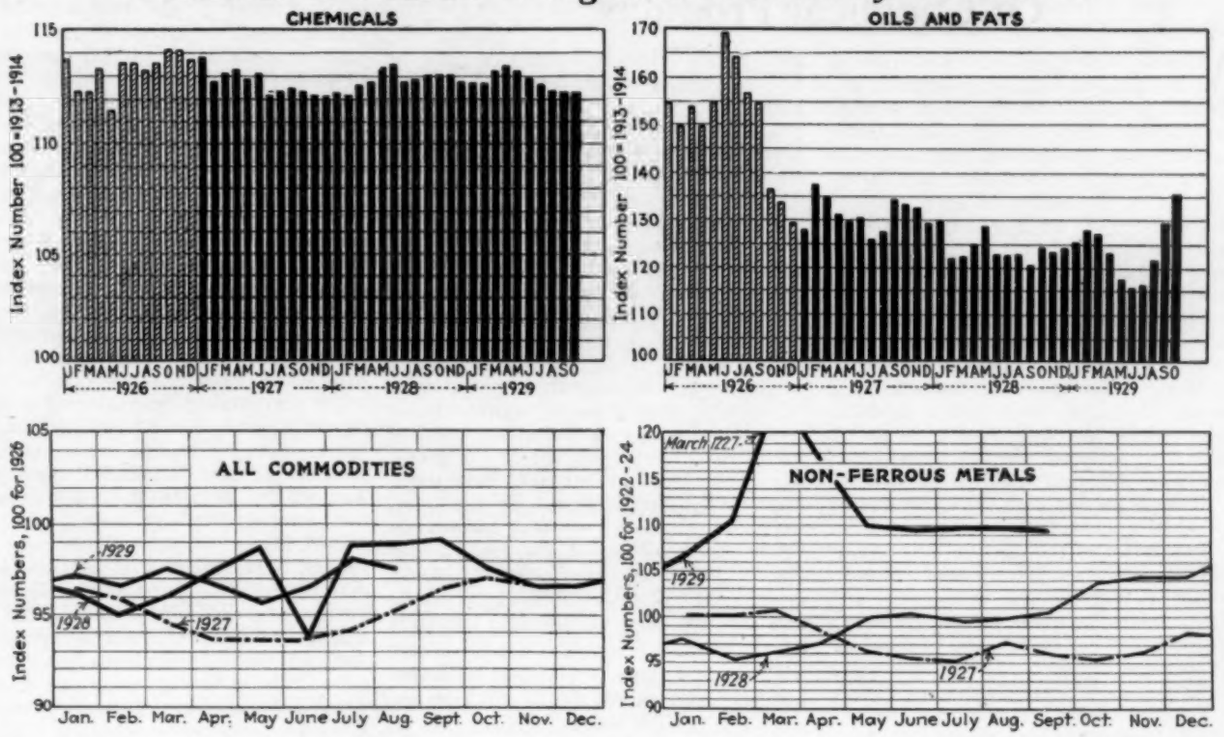
Exports of Chemicals

	August, 1928	August, 1929
Benzol, gal.	2,706,276	896,245
Acid, sulphuric, lb.	291,035	641,492
Acid, boric, lb.	339,810	342,784
Other acids, lb.	879,616	563,332
Methanol, gal.	14,000	33,849
Glycerin, lb.	138,517	46,497
Acetone, lb.	306,238	267,633
Formaldehyde, lb.	183,135	134,741
Ammonium compounds, lb.	84,122	92,840
Aluminum sulphate, lb.	3,549,023	5,075,858
Acetate of lime, lb.	1,141,308	.....
Calcium carbide, lb.	548,345	508,047
Bleaching powder, lb.	1,648,462	342,383
Copper sulphate, lb.	524,433	312,910
Potassium compounds, lb.	266,542	146,784
Sodium bichromate, lb.	537,412	319,111
Sodium cyanide, lb.	105,362	29,846
Borax, lb.	8,013,167	10,702,522
Sodium carbonate, lb.	6,959,275	9,362,566
Sodium silicate, lb.	6,128,712	5,972,141
Caustic soda, lb.	10,505,167	9,980,614
Other sodas, lb.	14,612,064	17,863,513
Sulphate of ammonia, ton.	8,569	9,327
Sulphur, ton	55,404	68,215

Imports of Chemicals

	August, 1928	August, 1929
Dead or creosote oil, gal.	9,901,790	7,523,812
Pyridine, lb.	17,369	804
Coal-tar acids, lb.	208,825	165,655
Coal-tar intermediates, lb.	107,290	75,637
Arsenic, white, lb.	702,670	1,577,070
Acid, acetic, lb.	.....	2,359,489
Acid, formic, lb.	100,147	73,911
Acid, oxalic, lb.	75,578	84,475
Acid, sulphuric, lb.	2,520,865	2,550,750
Acid, tartaric, lb.	282,240	224,448
Ammonium chloride, lb.	514,301	439,637
Ammonium nitrate, lb.	1,319,189	618,057
Barium compounds, lb.	851,234	321,726
Calcium carbide, lb.	372,000	100,000
Cobalt oxide, lb.	39,035	52,655
Copper sulphate, lb.	601,990	228,312
Bleaching powder, lb.	163,512	158,230
Glycerin, crude, lb.	21,420	1,140,986
Glycerin, ref., lb.	143,346	119,734
Iodine, lb.	46,056	8,521
Magnesium compounds, lb.	1,359,605	1,183,287
Potassium cyanide, lb.	21,661	50
Potassium carbonate, lb.	1,284,441	1,518,950
Caustic potash, lb.	1,044,587	1,126,848
Cream of tartar, lb.	30,239	.....
Potassium chlorate, lb.	1,079,988	1,018,696
Sodium cyanide, lb.	3,600,504	3,794,876
Sodium ferrocyanide, lb.	113,587	183,650
Sodium nitrate, lb.	11,684	.....
Sodium nitrate, ton	75,318	51,684
Sulphate of ammonia, ton.	219	1,310

CHEM. & MET. *Weighted Indexes of* PRICES



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Market Conditions Point to Steady Prices for Chemicals

UNDERLYING conditions indicate that a fairly steady price level for chemicals will rule, not only for the near future but also throughout the coming year. This is based on the fact that current values are well established, both for raw materials and finished products; that a large part of 1930 production will be sold ahead, and that very little, if any, change in contract prices for important chemicals seems in prospect.

Producers of bichromates already have announced that they will accept new contracts on the old price basis. While quotations on alkalis for forward positions have not been definitely fixed, business has been placed at about the same figures as prevailed for 1929 deliveries. Mineral acids likewise have held a steady price course, although reports of lower production costs have been heard in connection with some selections. Unverified reports have reached the market that recent sales of sulphur have gone through at concessions from the quoted levels. Improved processes in the manufacture of acids also have been stressed, but trade opinions incline to the belief that sales prices are to be maintained, for some time at least, because of the close relationship between supply and demand.

Chemicals which find their largest consuming outlets in the fertilizer trade have shown an easier price trend in the last year. With an increase in productive capacities and the probability of a continuance of keen competitive selling, the outlook is more favorable for a further lowering of values rather than an advance.

The metal salts follow rather closely the fluctuations in the metal market. Copper, which has moved in an irregular way in the last year, is in a doubtful position at present. According to some views the statistical position is strong but conservative opinion, tempered by a desire for price standardization, holds that high prices restricted consumption and as recent activity in the market has not been up to expectations the chances of a sustained upward trend are regarded as remote.

Values for vegetable oils have strengthened, largely under the influence of the linseed market. High prices for linseed increased interest in China wood oil and in the other oils which can be used in conjunction with, or can be substituted for, linseed oil. Imports of vegetable oils also have fallen off in volume and this has given an opportunity to reduce the large holdings of spot supplies and thus steady the market. So far as underlying conditions are concerned, linseed oil appears to be on a justified price level with future trends dependent upon the final outturn in the Argentine. Oils such as coconut and palm have been selling at prices too low to be maintained; prices which would not have been reached had not importers increased shipments unduly.

The position of cottonseed oil is more involved. To begin with, there was a large carryover of old crop oil. The seed supply, while smaller than had been anticipated some weeks ago, promises an adequate supply of new crop oil. Large stocks of lard contribute to the bear side of the market.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.32**
Last month	112.37
October, 1928	113.09
October, 1927	112.39

Steady prices in general ruled throughout the market for chemicals. Caustic potash was lowered in price and the weighted index number settled slightly below the level of a month ago. Changes are not anticipated in contract prices.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**135.56**
Last month	129.19
October, 1928	124.39
October, 1927	133.77

Under the leadership of linseed oil, practically all the vegetable oils rose in price during the month. Menhaden oil and animal fats also sold at higher levels. The result was shown in a sharp upward movement of the index number.

Export Outlets Aid in Distribution Of Chemical Products

AN ANALYSIS of statistics covering our export trade in chemicals and related products reveals that foreign markets not only take a considerable part of our production but also are increasing their orders for such products. It is impossible to give a grand total for exports on a quantity basis, as many commodities are reported only in terms of value. The increase in valuation for such export trade for the first seven months of the year, however, makes it apparent that there has been a marked gain in tonnage.

Official compilations for export trade classify chemicals and related products under eight groups. Data covering values of exports for the first seven months of this year indicate an increase in all these groups with the exception of industrial chemical specialties and even in that instance the decline was unimportant. In the other groups the percentage of increase was noteworthy and offers convincing evidence that considerable progress has been made in developing foreign markets. The co-operation which has been extended to exporters by the various branches of the Department of Commerce undoubtedly has been of material assistance in this development.

REVIEWING the coal-tar group, attention is drawn to the steady upward climb of the totals for colors, dyes, and stains. For the seven month period export shipments this year reached a total of 21,469,650 lb. This compares with 15,544,487 lb. and 14,059,787 lb. for the corresponding periods of 1928 and 1927. This represents a gain of 52.7 per cent for this year as compared with 1927.

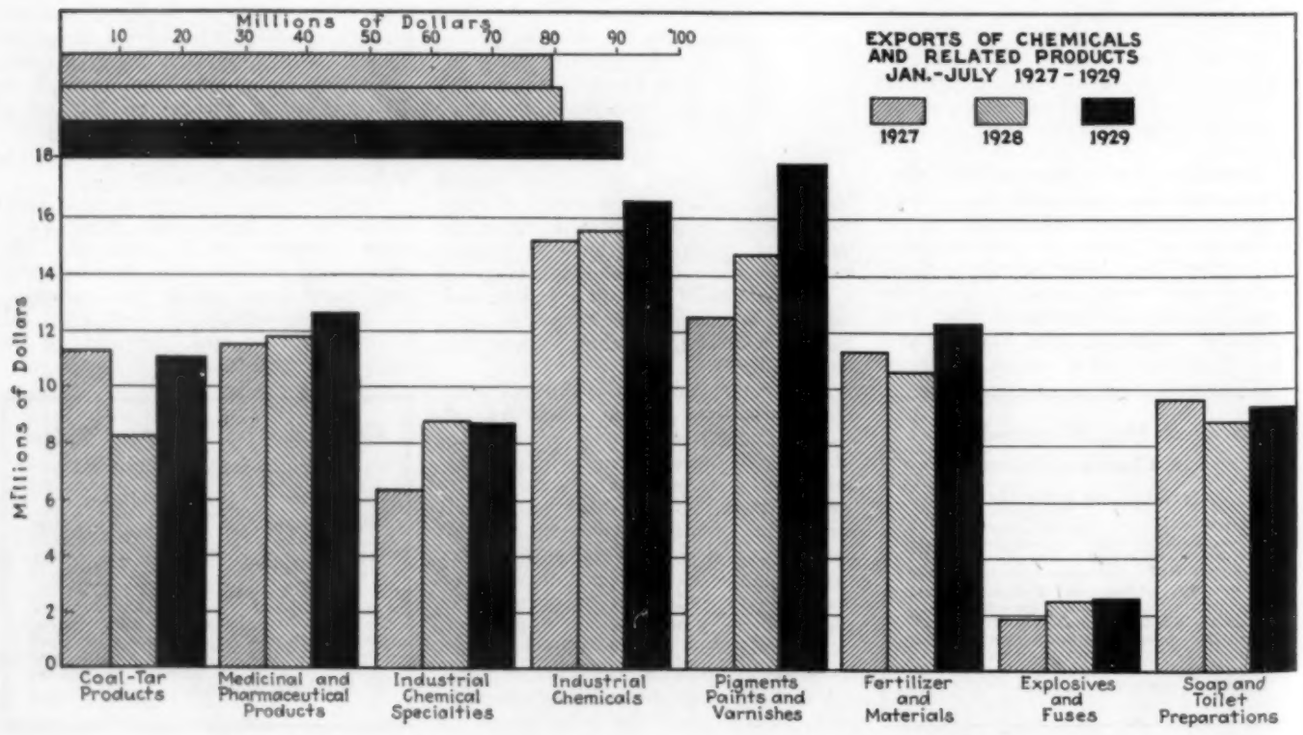
There was very little change in export demand for coal-tar intermediates with crudes showing variable, some moving in a larger way while others lost ground. Benzol, which had suffered a setback in export trade in 1928, was in larger supply this year, and in consequence exports were 21,666,720 lb. for the January-July period in comparison with 12,562,126 lb. for the corresponding time in 1928.

The industrial chemical group was reported at a total which represents an increase of nearly 22 per cent over that for 1928. Fluctuations within the group were numerous but increases were more important than declines, as the total indicates. Exports of soda compounds shows some falling off, the totals being 306,582,143 lb. this year and 308,180,061 lb. in 1928. Notable on the unfavorable side was the drop of nearly 13,500,000 lb. in shipments of borax. However, borax was shipped in record amounts last year and export trade still is large with the possibility that a more favorable showing will be made when the returns for the entire year become available. Silicate of soda is making a record in the export trade this year with a gain of about 27 per cent over the preceding year. Carbonate of soda and caustic soda are included among the items for which larger shipments were reported. In each case the improvement was substantial. The active call which has existed for some time for acetate of lime in domestic markets and the drop in production of that chemical are reflected in the export figures, as the amount shipped abroad was very small and evidently this material has lost its position in export trade. Bichromate of soda also has been losing ground in foreign markets with less than one-half the amount shipped this year as compared with 1928.

Of outstanding interest in the paint, pigment, and varnish group are the larger amounts of zinc oxide and lithopone which have found their way out of the country. For the seven month period last year, exports of zinc oxide were 15,801,402 lb. while for the present year the total is reported at 22,019,692 lb. The totals for lithopone in the same period are 3,674,168 lb. in 1928 and 6,078,976 lb. in 1929. Carbon black has been benefited by the enlarging of tire production in foreign countries and 56,496,292 lb. represents outward shipments this year as against 44,079,931 lb. in the corresponding period of 1928.

Exports of Chemicals, by Groups—Jan.-July, 1927-1929

	Value, 1927	Value, 1928	Value, 1929
Coal-tar products	$11,213,363	$8,253,985	$11,061,278
Medicinal and pharmaceutical chemicals	11,593,646	11,837,762	12,643,559
Industrial chemical specialties	6,202,328	8,788,990	8,777,114
Industrial chemicals	15,118,562	15,582,917	16,533,277
Pigments, paints, and varnishes	12,404,419	14,699,782	17,931,873
Fertilizers and fertilizer materials	11,190,867	10,545,420	12,172,545
Explosives and fuses	1,920,940	2,535,867	2,600,476
Soap and toilet preparations	9,586,867	8,850,186	9,281,572
Totals	$79,230,994	$81,094,909	$91,001,694



MARKET APPRAISAL OF CHEMICAL INDUSTRY

Statement of American Commercial Alcohol Corporation as of June 30, 1929, shows total assets of $10,795,802, comparing with $8,916,087 on Dec. 31, 1928, and earned surplus of $570,264 against $592,795. Current assets were $4,275,943, and current liabilities $1,771,439 as compared with $3,349,304 and $984,167, respectively, at end of 1928.

August net profit of Glidden Company was $262,733, after charges, depreciation and federal taxes, against $194,656 in August, 1928. Net profit for ten months ended Aug. 31, amounted to $2,353,508 after charges, compared with $1,550,966 in corresponding period of 1928.

Freeport Texas Company reports for quarter ended August 31, 1929, net profit of $869,357 after expenses and reserves for depreciation and taxes, equivalent to $1.19 a share on 729,844 no-par shares of stock. This compares with $1,136,482, or $1.55 a share, in preceding quarter and $680,962 or 93c. a share in third quarter of previous fiscal year.

United Dyewood Corporation reports, for the six months ended June 30, 1929, consolidated net profit of $187,867, after depreciation, federal taxes, general reserves and other charges, equivalent, after subsidiary and dividend requirements on the 7 per cent preferred stock, to 27 cents a share on 139,183 shares of common stock.

Stockholders of Dow Chemical Company have approved increase in authorized common stock to 1,000,000 no-par shares from 200,000 shares and issuance of four additional shares for each share held.

Pennsylvania Salt Manufacturing Company for year ended June 30, 1929, reports net income of $1,495,939 after depreciation, depletion, development and research reserve and federal taxes, equivalent to $9.97 a share on 150,000 shares of stock. This compares with $1,240,453 or $8.27 a share in preceding year.

General Paint Corporation, organized in October, 1928, as a consolidation of eleven Pacific Coast paint companies, reports for six months ended June 30, 1929, net profit of $434,341 after charges and taxes, equivalent to $1.71 a share on combined 253,500 shares of Class A and Class B no-par stocks.

American Cyanamid Company is offering stockholders the right to subscribe to one new share of Class B common stock for each two shares of Class A or Class B common now held at $30 a share.

Report of Davison Chemical Company and subsidiaries for year ended June 30, 1929, shows profit of $1,643,434, after expenses, charges and reserves for depreciation, etc., but before federal taxes. This compares with profit of $2,930,062 including $1,914,069 received from purchasers of 80,000 shares of Silica Gel Corporation stock, in preceding year.

Price Range Jan. High	Price Range Sept. Low	Stock	Price Range in September — September 3	High	Low	Sept. 30
218⅞	95½	Air Reduction	216	218⅞	194½	204
11½	2½	Ajax Rubber	4¼	4¼	2½	3½
354½	241	Allied Chemical	352	354½	312½	315
125	120½	Allied Chemical, pf	122½	123	121	....
23⅜	9¼	Am. Ag. Chemical	11⅛	12⅜	9¼	9⅜
73¼	38¼	Am. Ag. Chemical, pf	46¾	46¾	38¼	38¼
69½	39½	American Cyananid, B	64½	69½	52½	53
10	6	American Hide & Leather	8½	8½	7½	8
81¼	50	American Metal	72¾	79¼	72	72
37	31¼	Am. Solvents & Chemical	....	....	....	31¼
45¾	33	Anglo-Chile-Nitrate	....	....	....	33¾
49½	29	Archer-Daniels-Midland	36¾	44¾	33¼	39½
27½	6½	Assoc. Dyeing & Printing	9	10¼	6¼	7½
140	90	Atlas Powder	....	....	....	134½
32½	20	Beacon Oil	28	31	27½	28¾
101	73	Beechnut Packing	....	94¼	83	85½
89½	78¾	Bon Ami, A	82	83	80	83
31	25	California Petroleum	....	31	29¾	31
57¼	25¾	Celanese	35½	44	31	31
122	80½	Celanese, pf	87¾	96½	87¾	88
32	16½	Certainteed	28¼	29¾	26¾	27½
50	35	Chickasha Cotton Oil	36½	37	35	35¾
80¾	63	Colgate-Palmolive-Peet	....	80¾	65½	79½
700	225½	Commercial Solvents	494	700	484	620
118¾	82	Corn Products	111	118¾	108¾	113
69½	42¾	Davidson Chemical	47¾	54¾	47¾	52
64¼	43½	Devoe & Reynolds	44¾	48¼	44¼	45
115½	112	Devoe & Reynolds, pf	115	115	112	....
231	155¾	Du Pont	217½	231	188½	188½
119¾	112	Du Pont, 6 p.c. deb	117¾	118½	115¾	....
227¾	168	Eastman Kodak	214¼	225¾	199	221
309	202½	Firestone Tire	240¼	241	202½	227
20½	6¼	Fisk Rubber	8	9	6¾	7
109½	65¼	Fleischmann Co	99½	109½	98¼	....
54¼	37¼	Freeport, Texas	51¾	51¾	43½	43½
64½	36¾	Glidden Co	58	63	53¾	54¾
106½	101¼	Glidden Co., pf	105	105	102¼	104
82	53½	Gold Dust	63¾	69¾	60¼	114½
105¾	68	Goodrich Co	72¾	73¾	68	68¾
....	....	Hercules Powder	....	123	123	....
109	68½	Houston Oil	77½	98¼	74	97¼
135	75	Industrial Rayon	....	97	83	....
17¾	6½	Int. Ag. Chemical	7¼	7¾	6¼	7
88½	53	Int. Ag. Chemical, pf	53¼	56	53¼	....
37½	25	International Paper	35	36	33¾	34½
90	55½	International Salt	76¼	80	75½	75½
24	7¾	Kelley-Springfield	11	11	7¾	8¼
25	10	Lee Rubber & Tire	12	13	10½	10¾
68½	40	Lehn & Fink	47¾	48¾	42	44
43	37	Libby Owens	41	42½	37	39
113¾	71¾	Liquid Carbonic	91¾	94¼	83¾	85¾
72¾	42¼	Mathieson Alkali	61¼	72¾	57½	65¾
77½	72½	Monsanto Chemical	....	....	....	....
58	33	Nat'l Dist. Products	51¼	54¾	45	47¼
194¾	132	National Lead	165½	194¾	162	180
87¼	75¾	New Jersey Zinc	84¼	87¼	84	....
79¼	64¼	Ohio Oil	75½	79¼	74¼	78
89½	75	Owens Ill. Glass	77¼	89½	76	....
47	35	Phillips Petroleum	38¾	39½	36¾	37½
76¾	64	Pittsburgh Plate Glass	....	68¾	67	....
85	63½	Pratt & Lambert	....	80	69¾	71½
98	85	Procter & Gamble	95	95	85	85½
30¼	23¼	Pure Oil	26½	27½	25½	25½
105½	81	Sherwin-Williams	....	96	90	90
48¾	20¾	Silica-Gel	29¾	35¾	28¾	29¾
45	31½	Sinclair Oil	38¼	38½	34	34½
46½	32¾	Skelly Oil	42	45	39¾	40½
81¼	64	Standard Oil, Cal	77¾	79¾	72¾	73¾
83	48	Standard Oil, N. J	71¼	83	67¼	73¾
48½	37¾	Standard Oil, N. Y	44½	48½	40½	43¾
9¾	3½	Standard Plate Glass	4	4	3½	3½
84¾	57	Sun Oil	74⅞	84½	72	....
....	....	Swan & Finch	....	14	14	....
20¾	16	Tennessee Copper & Chemical	18	20½	17½	17½
71¼	57½	Texas Corporation	70½	71¾	65	65½
85½	67¾	Texas Gulf Sulphur	72¾	73¾	67½	67½
40	27⅛	Tidewater Oil	34½	35	33	33½
550	305	Tubize Silk	390	397½	335	....
140	75½	Union Carbide	135¾	140	120	122¾
54½	45½	Union Oil, Cal	54¾	57	50½	55¼
48¾	35½	United Piece Dye	42½	43¾	35½	35½
226½	128	U. S. Ind. Alcohol	208¾	226½	199½	210
35½	17¾	U. S. Leather	24½	24½	20½	21¾
65	42	U. S. Rubber	47	58¼	45½	52¼
133¾	105½	Vacuum Oil	125½	126¾	120½	121½
116½	68	Vanadium Corp	84½	100	80¼	85
83	43½	Vick Chemical	48¾	51¾	43½	45
24¾	9½	Va.-Ca. Chemical	12	12½	9½	10¾
65½	35	Va.-Ca. Chemical, pf	....	87	85	35½
48	30½	Wesson Oil	34¾	36¾	32½	33
13½	5½	Wilson & Co	7¼	7½	5½	5¾

CURRENT PRICES *in the* NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to October 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.14 -$0.15	$0.14 -$0.15	$0.14 -$0.15
Acid, acetic, 28%, bbl., cwt.	3.88 - 4.03	3.88 - 4.03	3.62½ - 3.87½
Boric, bbl, lb.	.05½ - .06	.05½ - .06	.06½ - .07
Citric, kegs, lb.	.46 - .47	.46 - .47	.46 - .47
Formic, bbl, lb.	.10½ - .11	.10½ - .11	.11 - .12
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl., lb.	.11 - .11½	.11 - .11½	.12 - .12½
22%, tech., light, bbl., lb.	.05½ - .06	.05½ - .06	.05½ - .06
Muriatic, 18°, tanks, cwt.	.85 - .90	.85 - .90	.85 - .90
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.00 -20.00	18.00 -20.00	18.00- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .11½
Phosphoric, tech., c'bys., lb.	.08½ - .09	.08½ - .09	.08½ - .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl., lb.	.38½ - .39	.38 - .39	.38 - .39
Tungstic, bbl., lb.	1.30 - 1.40	1.30 - 1.40	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl., gal.	2.68½ - 2.71	2.68½ - 2.71	2.68½ - 2.71
Alcohol, Butyl, tanks, lb.	16½ - .17	.16½ - .17	.18½ - .19
Denatured, 190 proof			
No. 1 special dr., gal.	.51 -	.51 -	.47 - .....
No. 5, 188 proof, dr., gal.	.51 -	.51 -	.47 - .....
Alum, ammonia, lump, bbl., lb.	.03½ - .04	.03½ - .04	.03½ - .04
Chrome, bbl., lb.	.05½ - .05½	.05½ - .05½	.05½ - .06
Potash, lump, bbl., lb.	.03 - .03½	.03 - .03½	.02½ - .03½
Aluminum sulphate, com., bags, cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Aqua ammonia, 26°, drums., lb.	.03 - .04	.03 - .04	.03 - .04
Ammonia, anhydrous, cyl., lb.	.14 -	.14 -	.13½ - .....
Ammonium carbonate, powd. tech., casks, lb.	.12 - .13	.12 - .13	.12 - .13
Sulphate, wks., cwt.	2.10 -	2.10 -	2.35 - .....
Amylacetate tech., drums, gal.	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Antimony Oxide, bbl., lb.	.09 - .10	.09 - .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs., lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	58.00 -60.00	58.00 60.00	57.50 60.00
Chloride, bbl., ton	65.00 -67.00	65.00 -67.00	63.00 70.00
Nitrate, cask, lb.	.07½ - .08	.07½ - .08	.08 - .08½
Blanc fixe, dry, bbl., lb.	.03½ - .04	.03½ - .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.02½ - .03	.02½ - .03	.02½ - .03
Bromine, cs., lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags., cwt.	4.50 -	4.50 -	4.00 - .....
Arsenate, dr., lb.	.07 - .08	.07 - .10	.06½ - .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	20.00 -	20.00 -	20.00 - .....
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½ - .07	.06½ - .07	.06½ - .07
Chlorine, liquid, tanks, wks., lb.	.03 - .03½	.03 - .03½	.03½ - .04½
Cylinders	.05 - .08	.05 - .08	.05½ - .08
Cobalt oxide, cans, lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton.	15.00 - 16.00	15.00- 16.00	16.00 -17.00
Copper carbonate, bbl., lb.	.22 - .23	.22 - .23	.17 - .18
Cyanide, tech., bbl., lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl., cwt.	5.50 - 6.00	6.00 - 6.10	5.30 - 5.50
Cream of tartar, bbl., lb.	.26 - .26½	.26 - .26½	.27½ - .28
Diethylene glycol, dr., lb.	.10 - .15	.10 - .15	.10 - .15
Epsom salt, dom., tech., bbl., cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, bl.	12.5 -	12.5 -	.83 - .....
Formaldehyde, 40%, bbl., lb.	.08½ - .09	.08½ - .09	.08½ - .09
Furfural, dr., lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums, gal.	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Galubers salt, bags, cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.14 - .14½	.13½ - .14½	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb.	.09 -	.09 -	.08½ - .....
White, basic sulphate, sck., lb.	.08½ -	.08½ -	.07½ - .....
Red, dry, sck., lb.	.10 -	.10½ -	.09½ - .....
Lead acetate, white crys., bbl., lb.	.13 - .14	.14 - .14½	.13 - .13½
Lead arsenate, powd., bbl., lb.	.13 - .14	.13 - .14	.12 - .13
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 - .....
Litharge, pwd., csk, lb.	.09½ -	.09½ -	.08½ - .....
Lithopone, bags, lb.	.05½ - .06	.05½ - .06	.05½ - .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06½ - .07
Methanol, 95%, tanks, gal.	.55 -	.55 -	.55 - .....
97%, tanks, gal.	.55 -	.55 -	.55 - .....
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.10 - .11
Single, bbl., lb.	.13 - .13½	.13 - .13½	.10½ - .11½
Orange mineral, csk., lb.	$0.12½ -	$0.12½ -	$0.11½ - .....
Phosphorus, red, cases, lb.	.55 - .57	.55 - .57	.62 - .65
Yellow, cases, lb.	.32 - .33	.32 - .34	.32 - .33
Potassium bichromate, casks, lb.	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½ - .06	.05½ - .06	.05½ - .06
Chlorate, powd., lb.	.07½ - .08½	.07½ - .08½	.06½ - .07
Cyanide, cs., lb.	.52 - .55	.52 - .55	.51 - .53
First sorts, csk., lb.	.08½ - .09	.08½ - .09	.08½ - .09
Hydroxide (c'stic potash) dr., lb.	.06½ - .06½	.07½ - .07½	.07½ - .07½
Muriate, 80% bgs., ton	36.75 -	36.75 -	36.40 - .....
Nitrate, bbl., lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.15 - .16
Prussiate, yellow, casks, lb.	.18½ - .19½	.19 - .19½	.18 - .19
Sal ammoniac, white, casks, lb.	.046 - .05	.046 - .05	.047 - .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	18.00 -20.00	16.00 -18.00	14.00 -17.00
Soda ash, light, 58%, bags, contract, cwt.	1.32 -	1.32 -	1.32 - .....
Dense, bags, cwt.	1.35 -	1.35 -	1.35 - .....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90 - 3.00	2.90 - 3.00	3.00 - 3.10
Acetate, works, bbl., lb.	.06½ - .07	.05 - .05½	.05½ - .06
Bicarbonate, bbl., cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton.	15.00 - 16.00	12.00 -15.00	3.00 - 3.50
Bisulphite, bbl., lb.	.03½ - .04	.03½ - .03½	.03½ - .04
Chlorate, kegs, lb	.07½ - .08	.07 - .07½	.06½ - .06½
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.18 - .22	.18 - .22	.18 - .22
Fluoride, bbl., lb.	.08½ - .09½	.08½ - .09½	.08½ - .09
Hyposulphite, bbl., lb.	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00
Nitrate, bags, cwt.	2.10 -	2.10 -	2.15 - .....
Nitrate, casks, lb.	.07½ - .08	.07½ - .08	.07½ - .08
Phosphate, dibasic, bbl., lb.	.03½ - .03¾	.03½ - .03¾	.03¾ - .03½
Prussiate, yel. drums, lb.	.11½ - .12	.11½ - .12	.11½ - .12
Silicate (30°, drums), cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr., lb.	.02½ - .03½	.02½ - .03	.03½ - .04
Sulphite, cyrs., bbl., lb.	.03 - .03½	.02½ - .03	.02½ - .03
Strontium nitrate, bbl., lb.	.09 - .09½	.09 - .09½	.09 - .09½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 - .....
Chloride, dr., lb.	.04 - .05	.04 - .05	.04 - .05
Dioxide, cyl., lb.	.07 - .08	.09 - .10	.09 - .10
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	.14½ -	.14½ -	.15½ - .....
Oxide, bbl., lb.	.46 -	.53 -	.53 - .....
Crystals, bbl., lb.	.35 -	.35 -	.37½ - .....
Zinc chloride, gran., bbl., lb.	.06½ - .06½	.06½ - .06½	.06½ - .06½
Carbonate, bbl., lb.	.10½ - .11	.10 - .10½	.10 - .11
Cyanide, dr., lb.	.41 - .42	.40 - .41	.40 - .41
Dust, bbl., lb.	.09½ - .10	.08½ - .09	.09 - .10
Zinc oxide, lead free, bag, lb.	.06½ -	.06½ -	.06½ - .....
5% lead sulphate, bags, lb.	.06½ -	.06½ -	.06½ - .....
Sulphate, bbl., cwt.	3.25 - 3.75	2.75 - 3.00	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.13½ -$0.14	$0.13½ -$0.14	$0.13½ -$0.14
Chinawood oil, bbl., lb.	.15½ -	.14½ -	.14½ - .....
Coconut oil, Ceylon, tanks, N.Y., lb.	.07½ -	.06½ -	.08½ - .....
Corn oil crude, tanks, (f.o.b. mill), lb.	.08½ -	.07½	.08½ - .....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.08½ -	.07½ -	.08½ - .....
Linseed oil, raw, car lots, bbl., lb.	.16.3	.158	.102 - .....
Palm, Lagos, casks, lb.	.07½ -	.07½ -	.07½ - .....
Niger, casks, lb.	.07½ -	.07½ -	.07½ - .....
Palm Kernel, bbl., lb.	.08½ -	.08½ -	.09½ - .....
Peanut oil, crude, tanks (mill), lb.	.08½ -	.08½	.08½ - .....
Rap seed oil, refined, bbl., gal.	78 - .80	80 - 82	88 - 90
Soya bean tank (f.o.b. Coast), lb.	.11½ -	.09½ -	.09½ - .....
Sulphur (olive foots), bbl., lb.	.09 -	.09 -	.09½ - .....
Cod, Newfoundland, bbl., gal.	.61 - .65	.65 - .67	.68 - .69
Menhaden, light pressed, bbl., gal.	.68 - .70	.68 - .70	.60 - .62
Crude, tanks (f.o.b. factory), gal.	.50 -	.46 -	.42½ - .....
Whale, crude, tanks, gal.	.80 -	.80 -	.....
Grease, yellow, loose, lb.	.07½ -	.06½	.07½ - .....
Oleo stearine, lb.	.11½ -	.09½	.09½ - .....
Red oil, distilled, d.p. bbl., lb.	.10½ - .11	.09½ - .10	.09½ - .09½
Tallow, extra, loose, lb.	.08½ -	.07½ -	.08½ - .....

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra, lb.	.14½ - .15	.14½ - .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums, lb.	.60 - .65	.60 - .65	.60 - .65

Coal Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.67 - .70	.70 - .72
Benzoic acid, U.S.P., kgs, lb.	.51 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.23 - .25	.23 - .25	.22 - .23
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.68 - .70	.70 - .72	.73 - .75
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoleun, bbl., lb.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.	.42 - .43	.42 - .43	.45 - .47
H-acid, bbl., lb.	.60 - .63	.60 - .63	.63 - .65
Naphthalene, flake, bbl., lb.	.04½- .05	.04½- .05	.05 - .06
Nitrobenzene, dr., lb.	.09 - .10	.09 - .10	.08½ - .10
Para-nitraniline, bbl., lb.	.55 - .56	.55 - .56	.52 - .53
Para-nitrotoluine, bbl., lb.	.29 - .31	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.13½ - .15	.13½ - .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.75 - 1.90	1.75 - 1.90	1.35 - 1.50
R-salt, bbl., lb.	.44 - .45	.44 - .45	.47 - .50
Resorcinal, tech., kegs, lb.	1.30 - 1.35	1.30 - 1.35	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w., tanks, gal.	.30 - .35	.30 -	.35 -
Tolidine, bbl., lb.	.86 - .90	.86 - .90	.95 - .96
Toluene, tanks, works, gal.	.45 -	.45 -	.35 -
Xylene, com., tanks, gal.	.30 .40	.30 - .35	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.15½ .16	.15½ .16	.16½ .17
China clay, dom., f.o.b. mine, ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.08 - .13	.08 - .13	.06½ - .07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.31 - .32
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.08 - .35
Chrome green, bbl., lb.	.30 - .32	.30 - .32	.27 - .30
Carmine red, tins, lb.	6.00 - 6.50	6.00 - 6.50	5.25 - 5.50
Para toner, lb.	.75 - .80	.70 - .75	.70 - .80
Vermilion, English, bbl., lb.	1.90 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl., lb.	.17 - .17½	.17 - .17½	.15½ - .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.07½ - .08½	.07½ - .08½	.08 - .09
Cum copal Congo, bags, lb.	.07½ - .08	.07½ - .08	.07½ - .08
Manila, bags, lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, cases, lb.	.24 - .25	.24 - .25	.22 - .23
Kauri No. 1 cases, lb.	.48 - .53	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.), lb.	0.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -	40.00 -	40.00 -
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	9.40 -	8.50 -	9.55 -
Turpentine, gal.	.56½ -	.51 -	.53½ -
Shellac, orange, fine, bags, lb.	.60	.61	.61 - .52
Bleached, bonedry, bags, lb.	.54 - .56	.56 - .58	.60 - .66
T. N. bags, lb.	.43 - .44	.43 - .44	.47 - .48
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	9.50 -	9.50 -	10.50 -
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -	13.75 -	13.75 -

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.28 -$0.30	$0.28½ $0.31	$0.30 -$0.32
Beeswax, ref., light, lb.	.38 - .39	.38 - .40	.41 - .42
Candelilla, bags, lb.	.22 - .23	.21 - .22	.23 - .24
Carnauba, No. 1, bags, lb.	.33 .34	.37 - .38	.50 - .51
Paraffine, crude 105-110 m.p., lb.	.04½ .05	.04½ .05	.04½- .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00-	$200.00-	$200.00-
Ferromanganese, 78-82%, ton	105.00-	105.00-	105.00-
Spiegeleisen, 19-21%, ton	33.00-	33.00-	32.00-
Ferrosilicon, 14-17%, ton	45.00-	45.00-	45.00-
Ferrotungsten, 70-80%, lb.	1.45	1.35-	1.35- .98
Ferro-uranium, 35-50%, lb.	4.50-	4.50-	4.50-
Ferrovanadium, 30-40%, lb.	3.15- 3.75	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.18 -	$0.18½ -	$0.15½-
Aluminum, 96-99%, lb.	24 - 30	.24 - .26	.24 - .25
Antimony, Chin. and Jap., lb.	.08½	08½-	.09½-
Nickel, 99%, lb.	35	35 -	.35 -
Monel metal, blocks, lb.	28	28 28	28 -
Tin, 5-ton lots, Straits, lb.	42½	45½	49 -
Lead, New York, spot, lb.	069 -	0675 -	.065 -
Zinc, New York, spot, lb.	.071 -	0715 -	.066 -
Silver, commercial, oz.	49½	50½-	58½-
Cadmium, lb.	85 .95	85 - .95	70 - .80
Bismuth, ton lots, lb.	1.70	1.70 -	1.70 -
Cobalt, lb.	2.10 2.50	2.10 - 2.50	2.50 -
Magnesium, ingots, 99%, lb.	.85 1.10	.85 - 1.10	.85 - 1.10
Platinum, ref., oz.	65.00 66.00	65.00 - 66.00	76.00 76.50
Palladium ref., oz.	38.00 40.00	38.00- 40.00	42.00 46.00
Mercury, flask, 75 lb.	124.50 -	124.50 -	128.00 -
Tungsten powder, lb.	1.35 - 1.50	1.35 - 1.50	1.10 - 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$7.50- $8.00	$7.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post, ton	22.00- 25.00	22.00- 24.00	22.00- 23.00
Coke, fdry., f.o.b. ovens, ton	2.85- 3.00	2.85- 3.00	2.85- 3.00
Fluorspar, gravel, f.o.b. Ill., ton	18.00- 20.00	18.00- 20.00	17.00-18.00
Ilmenite, 52% TiO_2, Va., lb.	9.50- 11.00	.00½- .00½	.00½-
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	31 - 36	34 - .37	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	48 - .50	48 - .50	.48- .50
Monazite, 6% of ThO_2, ton	80.00-	80.00-	130.00-
Pyrites, Span. fines, c.i.f., unit	.13 -	.13 -	.13 -
Rutile, 94-96% TiO_2, lb.	.10 - .11	.11 - .13	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit	16.00- 17.00	15.00 -	11.25 -11.50
Vanadium ore, per lb. V_2O_5, lb.	40.00- 45.00	.28 -	nom. - nom.
Zircon, 99%, lb.	.03 -	.03 -	.03 -

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Alcohol Plant—Utah Industrial Alcohol Co., S. D. Huffaker, Secy., Salt Lake City, Utah, plans the construction of an alcohol plant at Springville. Estimated cost $60,000. Architect and engineer not selected.

Aluminum Factory — Aluminum Industries Inc., 2438 Beekman St., Cincinnati, O., is having preliminary plans prepared for the construction of a factory and warehouse at Los Angeles, Calif. Estimated cost to exceed $40,000.

Aluminum Powder Plant — Reynolds Metals Co., 30th St. and Grand Ave., Louisville, Ky., will build six 1 story factory buildings for the manufacture of aluminum powder at Camp Ground Rd. Estimated cost $120,000. A. G. Tafel, 140 South Third St., Louisville, is architect. Work will be done by owner's forces.

Bakelite Factory — Bakelite Corp., L. M. Rossi V. Pres., 350 Rector St., Perth Amboy, N. J. awarded contract for the construction of a factory at Bound Brook, to Francisco & Jacobus, 511 5th Ave., New York, N. Y. Estimated cost $40,000.

Battery Factory — Willard Storage Battery Co., East 131st St. and St. Clair Ave., Cleveland, O., is receiving bids for a 1 story storage battery factory at East 9th and Gerhart Sts., Los Angeles, Calif. Estimated cost $500,000. A. Beelman, 1019 Union Bank Bldg., Los Angeles, is architect.

Building Products Factory—Southern Building Co., and Certain-Teed Products Co., 100 East 42nd St., New York, N. Y., awarded contract for the construction of a plant for the manufacture of asphalt roofing of both slate and smooth surface and miscellaneous products at Savannah, Ga. to Artley Co., 504 Bay St., Savannah. Estimated cost $600,000.

Aniline and Chemical Factory—National Aniline & Chemical Co., 40 Rector Pl., New York, N. Y., plans extensive additions to plant on Abbot Rd., Buffalo.

Chemical Factory—Raffi & Swanson, 1012 Broadway, Chelsea, Mass., awarded contract for the construction of a 1 story chemical factory to W. Cline, 55 Spencer Ave., Chelsea.

Chemical Plant—Vestal Chemical Co., T. J. Pollnow, Pres., 215 Pine St., St. Louis, Mo., awarded contract for the construction of a 3 story, 60 x 120 ft. chemical plant on Manchester and Kingshighway, to Woermann Construction Co., 1441 Syndicate Trust Bldg., St. Louis. Estimated cost $70,000.

Scale House—Koppers Seaboard Coke Co., 504 Union St., Brooklyn, N. Y., plans the construction of a 24 x 28 ft. scale house at Jamaica Ave. and 184th St., Jamaica. Estimated cost $41,000. Rust Enineering Co., 30 Church St., New York, is engineer.

Ceramic Products Factory — Idaho Ceramics Materials Co., Moscow, Idaho, plans the construction of a factory. Estimated cost $50,000.

Flinkote Factory—Flinkote Co., Maple St., East Rutherford, N. J., will not construct factory addition $150,000 as reported in Aug. 12 issue. Project abandoned.

China Factory — Crooksville China Co., G. Crooks, Gen. Mgr., Crooksville, O., is having plans prepared for the construction of a 1 story, 70 x 142 ft. factory. Estimated cost $25,000. Private plans.

Glass Plant—DuPont Viscoloid Co., F. B. Davis, Pres., Leominster, Mass., plans the construction of a glass plant. Estimated cost $1,000,000. Private plans.

Graphite Plant—Annadale Graphite Co., Annandale, N. J., is having revised plans prepared for the construction of a 1 and 2 story addition to plant. Estimated cost $100,000. Private plans.

Delco Products Factory—Delco Products Co., East First St., Dayton, O., awarded contract for the construction of a 7 story, 67 x 135 ft., factory at Second and Madison Sts. to C. H. Shook, Third National Bank Bldg. Estimated cost $200,000.

Alloy Foundry—General Electric Co., River Rd., Schenectady, N. Y., awarded contract for the construction of a 1 story alloy foundry on East Lake Rd., Erie, Pa., to E. E. Austin & Sons, 1919 Reed St., Erie.

Nickel Plants Additions—International Nickel Co., A. S. Shoffstall, Gen. Mgr., 67 Wall St., New York, N. Y., awarded contract for the construction of two new units to plant to house machinery and equipment of American Mond Nickel Co., Clearfield, Pa., also 158 x 400 ft. unit to be cold drawn department at Huntington, W. Va., to Hatfield Construction Co., 722 14th St., Huntington.

Furnaces—Central Alloy Corp., F. J. Griffiths, Chn., Massillon, O., plans extensions and improvements to sheet rolling mill to include continuous pack and pair furnaces and electric drive equipment at Massillon, also a normalizing furnace at Canton plant. Estimated total cost $600,000. Private plans.

Steel Mill—Tarentum Steel Corp., G. Robinson, Pres., 1716 First National Bank Bldg., Pittsburgh, Pa., is having plans prepared for the construction of a steel mill at Tarentum. Estimated cost $3,000,000. L. F. Galbraith, Tarentum, is engineer.

Gas Storage Tanks—Bureau of Aeronautics, Navy Dept., Washington, D. C., awarded contract for twenty-six helium gas storage tanks 250,000 cu.ft. capacity to A. O. Smith Corp., 27th and Keefe Sts., Milwaukee, Wis.

Gas Storage Tanks—Goodyear Zeppelin Corp., 1144 East Market St., Akron, O., awarded contract for ninety-six helium gas storage tanks 1,000,000 cu.ft. total capacity at Akron Zeppelin field to A. O. Smith Corp., 27th and Keefe Sts., Milwaukee, Wis.

Gasoline Extraction Plant—Palmer Corp. of Louisiana, c/o Louisiana Gas & Fuel Co., 1100 City Bank Bldg., Shreveport, La., awarded contract for addition to gasoline extraction plant at Alto to Stearns-Rogers Mfg. Co., 1720 California St., Denver, Colo. Estimated cost $100,000.

Golf Club Factory — Kroydon Co., Burnett Ave., Maplewood, N. J., will receive bids about Oct. 15 for the construction of a 1 story, 30 x 150 ft. addition to factory for the manufacture of golf clubs. Estimated cost $40,000. D. A. Hopper, 22 Ridgewood Ave., Irvington, N. J., is architect.

Laboratory—Research Corp., East Main St., East Bound Brook, N. J., will soon award contract for the construction of a 1 story addition to laboratory. Estimated cost $40,000. J. N. Piersen & Son, 198 Jefferson St., Perth Amboy, are architects.

Laboratory (Chemistry)—Indiana University, Bloomington, Ind., is receiving bids for the construction of a chemistry laboratory. Estimated cost $350,000. R. F. Daggett, 922 Continental Bank Bldg., Indianapolis, is architect.

Laboratory (Chemistry)—University of Texas, c/o J. W. Calhoun, Comptroller, Austin, Tex., will receive bids until Nov. 8 for the construction of a 4 story chemistry laboratory, including equipment, etc., on Campus. Estimated cost $1,000,000. H. M. Greene and La Roche & Dahl, Builders Construction Bldg., Dallas, are architects.

Laboratory (Chemical) — Sandoz Chemical Works, 63 Vandam St., New York, N. Y., plans the construction of a chemical laboratory. C. D. Persina, 820 Lexington Ave., New York, is architect.

Laboratory (Engineering)—McDonald Bros. Inc., 131 State St., Boston, Mass., is having plans prepared for the construction of a 6 story, 175 x 500 ft. engineering laboratory at Oakman Blvd. and Pennsylvania R.R. Estimated cost $3,000,000. Private plans.

Laboratories (Experimental and Chemical)—Hercules Powder Co., Delaware Trust Bldg., Wilmington, Del., is having plans prepared for the construction of new experimental and chemical laboratories on Lancaster Pike.

Laboratory (Medical and Pediatric)—York University, New Haven Hospital, New Haven, Conn., will receive bids after Oct. 15 for a group of buildings including 4 and 6 story medical and pediatric laboratory at Davenport Ave. Estimated total cost $4,350,000. J. Russell Pope, 542 5th Ave., New York, N. Y., is architect.

Laboratory (Physics) — Harvard College, Harvard Sq., Cambridge, Mass., plans the construction of a physics laboratory. Estimated cost $500,000. Coolidge, Shepley, Bulfinch & Abbott, Ames Bldg., Boston, are architects.

Laboratory, etc.—Boyce Thompson Institute, Yonkers, N. Y., will soon award contract for a 2 story laboratory and office at North Broadway and Odell Ave. Estimated cost $400,000. F. A. Colby, 705 5th Ave., New York, is architect. J. R. Seelman, 705 5th Ave., New York, is engineer.

Laboratories—A. T. and S. F. Hospital Association, c/o Atchison, Topeka & Santa Fe R.R., Topeka, Kan., awarded contract for the construction of a 5 story hospital including laboratories, etc. to G. Senna Construction Co., 1017 Kansas Ave., Topeka.

Laboratories, etc.—Schmidt, Garden & Erickson, 104 South Michigan Ave., Chicago, Ill., Archts., will receive bids until Oct. 24 for the construction of a nurses' home, laboratories, etc., on Calvin St., Pittsburgh, Pa., for Sisters Third Order of St. Francis, St. Francis Hospital, Pittsburgh. Estimated cost $1,000,000.

Lamp Works—Fougner & Gautier, 103 Park Ave., New York, N. Y., Archts., will receive bids about Nov. 1 for a 4 story, 100 x 140 ft. factory, for Tung Sol Lamp Works, Inc., 95 8th Ave., Newark, N. J. Estimated cost $150,000.

Leather Factory — Agoos Leather Co., 146 Boston St., Lynn, Mass., is having plans prepared for the construction of a 3 story, 50 x 150 ft. factory. Private plans.

Leather Products Factory — Omity Leather Products Co., West Bend, Wis., awarded contract for the construction of a 4 story, 64 x 138 ft. factory, to Hutter Construction Co., Fond du Lac. Estimated cost $134,015.

Limestone Products Factory—National Lime & Stone Co., Bluffton, O., plans to rebuild 2 story factory destroyed by fire. Estimated cost $100,000. Grinding and crushing machinery will be required.

Nitrogen Filtration Plant—Shell Development Co., Long Beach, Calif., is having preliminary plans prepared for the construction of first unit of nitrogen filtration plant. Initial cost $250,000. Ultimate total cost $5,000,000.

Paint Factory — Acorn Refining Co., 8205 Franklin Ave., Cleveland, O., awarded contract for a 3 story, 85 x 120 ft. addition to factory at West 81st St. and Franklin Ave., to Marvin B. Parker, Inc., Union Bld., Cleveland. Estimated cost $75,000.

Paint Factory—Ra Var Corp., New Haven, Conn., is having plans prepared for the construction of a 2 story, 80 x 120 ft. paint factory on Albert Ave., Newark, N. J. Estimated cost $70,000. Austin Co., 326 Frelinghuysen Ave., Newark, N. J., is architect.

Paper Factory—Barnes Wall Paper Co., A. G. Barnes, Treas., York, Pa., will receive bids until Oct. 25 for addition to paper factory. Estimated cost $15,000. H. E. and R. B. Yessler, Schmidt Bldg., Center Sq., York, are architects.

Paper Factory—American Reinforced Paper Co., Starkey Ave., Attleboro, Mass., awarded contract for additional unit to plant 1 story, 45 x 175 ft., on Starkey Ave. to C. K. Rathbone, Hospital Trust Bldg., Providence, R. I.

Paper Mill — E. B. Eddy Co. Ltd., C. V. Caesar, Gen. Mgr., Hull, Que., is having plans prepared for the construction of a new paper mill on Laurier Ave. Estimated cost $1,500,000. M. Pratt, c/o owner, is architect. Machinery and equipment including five modern paper making machines will be required.

Paper and Twine Factory—Federal Paper & Twine Co., F. E. Bensley, Pres., 180 East Mill St., Akron, O., is having plans prepared for the construction of a 3 story factory at 180 East Mill St. Estimated cost $40,000 to $50,000.

Pulp Mill, etc.—Olympia Forest Products Co., Port Angeles, Wash., plans immediate construction of two principal mill buildings. Contracts awarded for pulp and machine building to Chris Kupler's Sons, Port Angeles, 1,200 ft. wharf, to H. Cotton, Port Townsend, and driving 7,000 piles to constitute foundation of main structures to Owens Bros., Port Angeles. Total estimated cost $4,000,000.

Paste Factory — Reliable Paste Co., 3560 Shields Ave., Chicago, Ill., awarded contract for masonry, etc. for a 2 story, 75 x 105 ft. factory. Estimated cost $35,000.

Insulating Board Factory—Newport Co., J. H. McCormack, Pres., Pensacola, Fla., plans the construction of a plant for the manufacture of insulating boards. Estimated cost $1,000,000.

Filter House—Continental Refining Co., P. A. Anderton, Secy., Oil City, Pa., awarded contract for the construction of a 1 story, 22 x 126 ft. filter house on Rouseville Rd. to L. O. Boquin, 11 East First St., Oil City.

Plant—D. A. Lubricant Co. (oils), 29th and Canal Sts., Indianapolis, Ind., awarded contract for the construction of a plant to Brown & Mick Inc., 1020 East Michigan Ave., Indianapolis. Estimated cost $43,000.

Refinery Mill—Towagmac Exploration Co. Ltd., 620 Cathcart St., Montreal, Que., is having plans prepared for the construction of a refinery mill on Lake Geneva Mining Co.'s property at Sudbury, Ont. Lead and zinc concentrates will be products milled.

Refinery (Gold and Silver)—Pease & Curren, 403 Richmond St., Providence, R. I., awarded contract for a 1 and 2 story, 50 x 100 ft. additional unit to plant at Allens Ave. and Chapman St. to C. B. Maquire Co., Grosvenor Bldg., Providence. Estimated cost $40,000.

Refinery (Oil)—Allegheny Oil Co., D. F. Macintosh, Secy., 204 Walnut Ave., N.E., Canton, O., is having plans prepared for the construction of an oil refinery 12,000,000 bbl. capacity. A. G. McKee Co., 2425 Euclid Ave., Cleveland, is engineer.

Refinery (Oil)—Canadian Oil Companies Ltd., Petrolia, Ont., plans additional buildings, storage, and equipment on Tank St. Estimated cost $200,000.

Refinery (Oil) and Bulk Station—Standard Oil Co. of Pennsylvania, L. R. Wick, Peoples National Gas Bldg., Pittsburgh, Pa., will build a refinery and bulk station, including four 90 ft. tanks and storage buildings, equipment, etc., in Beaver County. Work will be done by separate contracts. Tanks awarded to Riter Conley Co., Oliver Bldg., Pittsburgh.

Refinery (Sugar) Power Plant — Imperial Sugar Co., Sugarland, Tex., plans the construction of a power plant in connection with present sugar refinery. Machinery and equipment will be required. Owner selling 10,000 shares preferred stock to defray expense of construction.

Stills—Utah Oil Co., J. Howard, Pres., Salt Lake City, Utah, plans the construction of a battery of new stills together with all piping and accessories. Estimated cost $500,000. G. A. Finlayson is engineer in charge.

Rubber Belt Plant—V. I. Shuse, Main St., Mahaffey, Pa., will build a 2 story, 24 x 150 ft. rubber belt plant on Main St. Rubberized Cord Belt Co., Mahaffey, is lessee. Work will be done by separate contracts.

Rubber Factory—Alfred Hale Rubber Co., Linden St., Quincy, Mass., awarded contract for additions and alterations to factory to Clark & Smith, 13 Temple St., Quincy.

Rubber Factory—Firestone Tire & Rubber Co., H. Firestone, Pres., South Main St., Akron, O., awarded contract for a 7 story, 110 x 180 ft. addition to factory, to C. W. & P. Construction Co., 718 Second National Bldg., Akron. Estimated cost $500,000.

Rubber Factory—Kent Rubber Products Co., J. Slater, Mgr., Ravenna, O., awarded contract for a 2 story, 50 x 90 ft. factory and office to P. L. Frank Construction Co., Ravenna. Estimated cost $40,000.

Rubber Factory—Oak Rubber Co., Ravenna, O., awarded contract for the construction of a 1 story, 50 x 126 ft. factory for the manufacture of rubber balloons and novelties to P. L. Frank Construction Co., Ravenna. Estimated cost $40,000.

Rubber Factory—Lockwood Green Inc., 100 East 42nd St., New York, N. Y., Archts. and Engrs., will receive bids about Oct. 15 for the construction of a 4 story factory for U. S. Rubber Co., 211 Passaic St. Estimated cost $1,000,000.

Soap Factory—Lever Bros., 164 Broadway, Cambridge, Mass., will build a 4 story soap factory at Harvard, Burleigh and Hastings Sts. Estimated cost $40,000. Stone & Webster Engineering Corp., 164 Broadway, Boston, are engineers. Work will be done by separate contracts.

Soap Factory — Washington White Mystern Soap Co., H. H. Ulrici, Pres., Seattle, Wash., plans the construction of a 2 story plant for the manufacture of soap. Estimated cost $50,000.

Smelter Plant—R. Turnbull, c/o Volta Mfg. Co., Welland, Ont., awarded contract for a ferro alloys smelting plant to McLarty Bros., Wellington St., Saulte Ste Marie, Ont. Estimated cost $100,000.

Tile Factory—National Tile Co., C. M. Anderson, Ind., awarded contract for the construction of a 100 x 145 ft. tile plant to David Eshelman, 714 North Jackson St., Anderson. Estimated cost $40,000.

Tile and Rubber Factory—Firestone Tire & Rubber Co., H. D. Firestone, Pres., South Main St., Akron, O., is having plans prepared for the construction of a 7 story, 110 x 180 ft. factory. Estimated cost $500,000. D. H. Hoener, c/o owenr, is chief engineer.

Wax Factory—H. H. Wiggin, 50 Terminal St., Charlestown, Mass., awarded contract for addition and alterations to factory at 413 Medford St. to Blake & Pope, 38 Chauncy St., Boston. Whittemore-Woodbury Co., Charlestown, manufacturers of shoemakers wax is lessee.

Zinc Plant—Evans-Wallower Zinc Co., Monsanto, Ill., is having plans prepared for addition to electricolytic zinc plant, 50 ton of lead daily capacity. Estimated cost $1,000,000.